an international monthly

THE Petroleum Engineer

Combined Edition

Drilling and Producing | Refining and Gas Processing | Oil and Gas Pipelining

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Table of Contents Page 3 • Advertisers' Index Page 6
NEW MACHINERY AND SUPPLIES E-45

JUNE 1951

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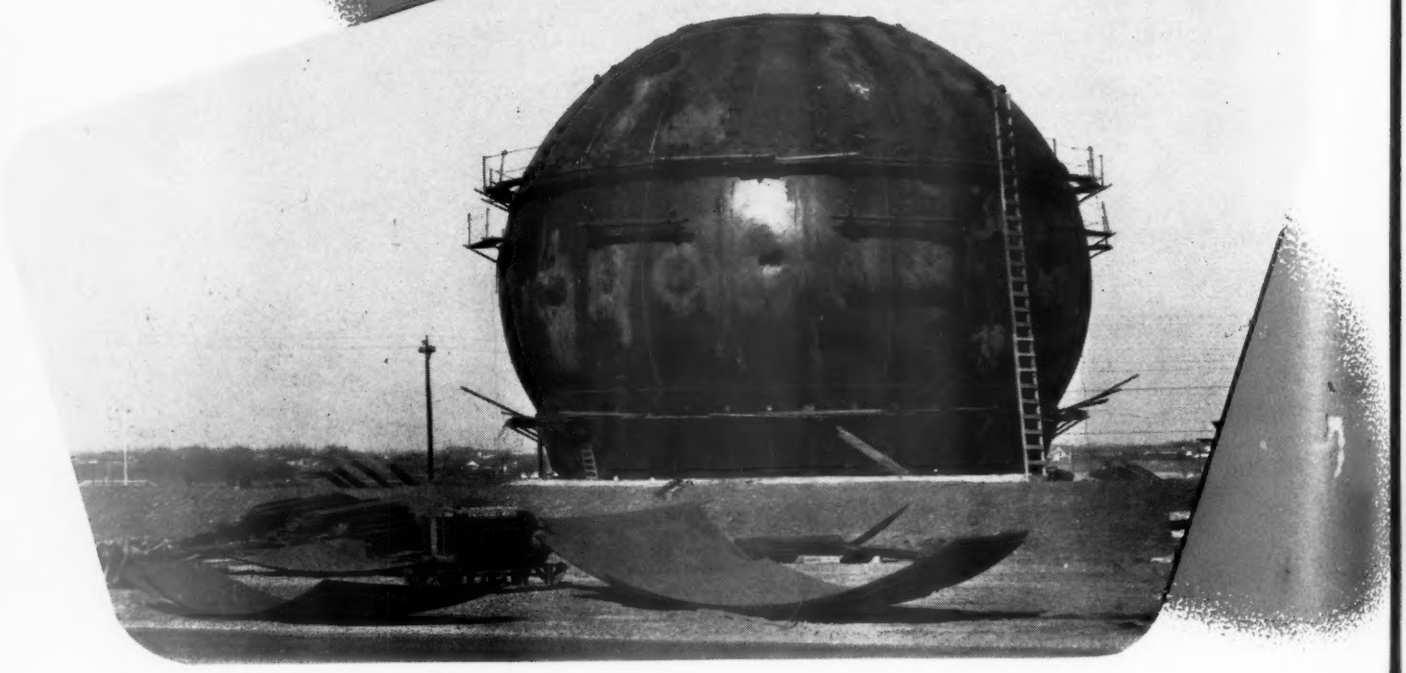

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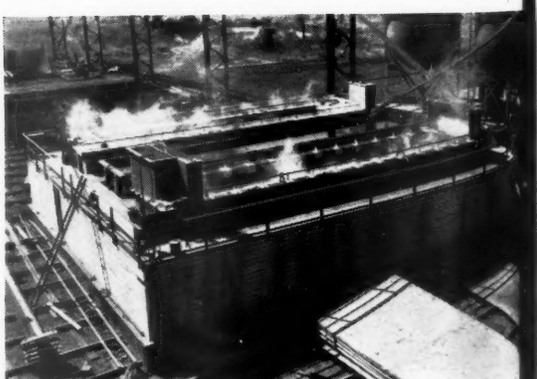

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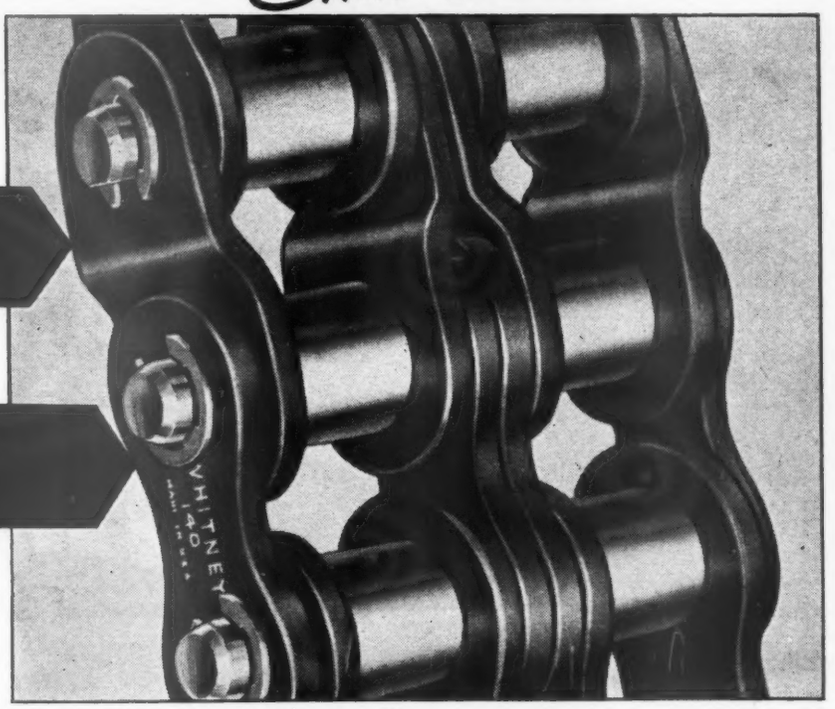

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JUNE, 1951 • VOLUME XXIII • NUMBER 6

GENERAL

Industry Smoothly Meets Record Demand A-39
Ernestine Adams
Petroleum and Natural Gas in Japan A-48
Leo W. Stach

Features

Course of Oil A-4
Scanning Washington's Oil Horizon A-8
Highlights in Oildom A-10
National Petroleum Situation A-12
Petrolic Personalities A-14
Dick Sneddon
Meetings A-18
Letters to the Editors A-24
Petroleum Profile A-64
Raymond L. Tollett
General News E-2
General Personals E-8
The Petroleum Engineer's Continuous Tables E-17
(Installment No. 167—Bibliography)
Laugh with Barney E-24
Oil and Gas Trade News E-26
Trade Personals E-35
New Machinery and Supplies E-47
Trade Literature E-54
Books E-61

DRILLING AND PRODUCING

Radioactivity Well Logging Anomalies B-7
John L. P. Campbell
Submersible 1800-Hp Drilling Barge Operates in Corpus Christi Bay B-14
G. Otis Danielson
Selection and Evaluation of Wells for Hydrafrac Treatment B-28
Joe W. Maly and Tom E. Morton
How Two-Way Radio Aids in Drilling B-40
Paul A. Greenmeyer
Reversible Connections for Rig Shifts B-48
Elton Sterrett
U. of T. Research Center B-50
Fred D. Thompson
Soluble Plug Systems Used to Control Paraffin Deposition B-54
K. Marshall Fagin
New Developments in Diamond Coring B-63
Robert A. Watson
Casing String Design Principles and Practices Part 1 ..... B-70
J. O. Hills
API Paper Given on Lightweight Aggregates and Gel Cements B-81
Underground Magnetic Logging Device B-87

Features

Editorial B-3
Why Limit Oil Exploration and Development?
News B-84
What's Doing in Drilling B-94
Exploration Activities B-98
Running Tour with Men in the Industry B-102

REFINING AND GAS PROCESSING

Studies in Fluidization C-5
H. L. Olin and J. S. Patterson
New Development in Radiant Heating C-14
C. C. Tate
Pan-Am Southern Corporation Dedicates Second Cat Cracking Unit C-18
The Instrument Department Grows Up C-23
Robert F. Angell and Robert Tobi
Alkylation Plant Improvements C-27
D. H. Putney
Fawley Refinery to Open in August C-36
Picture Story
The Technical Forum C-39
Pressure Drop in Exchangers
Aviation Fuel in Automotive Engines
Determination of Hydrocarbon Liquid-Vapor Equilibria C-41
G. L. Farrar
API Refiners Meeting Points the Way C-48
DPA Certificates Stopped on Refining Facilities C-56

Features

The Turnaround C-3
Training
News C-50
Refining and Gas Processing Personals C-54

OIL AND GAS PIPELINING

Calculation of Orifice Meter Coefficients D-5
J. W. J. Bercher
Microwave Communications Systems D-13
W. T. Bulla
U. S. Tanker Fleet Prospects D-20
Use of Barytes on Pipe Lines D-26
Frank H. Love
Natural Gas in Relation to National Defense D-31
Paul Kayser

Features

The Firing Line D-3
Too Many Pipe Lines?
More Steel for Line Pipe?
Pictorial D-38
News D-43
Pipe Line Personals D-48
Pipe Line Projects D-50
With the Pipe Line Contractors D-54

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the Course of OIL

Self-Sufficiency in Oil

THE daily rate of domestic crude oil production now exceeds six million barrels a day. If we are moving to the brink of another world war, what of domestic oil resources and national oil requirements? Can we continue to be self-sufficient in this vital resource? These are important questions of immediate concern.

"I believe the point can convincingly be made by geologists that there remains enough oil to be discovered within the economic reach of the drill in the United States to last for generations to come.

"I do not believe any prudent man would attempt to estimate how much, either in oil or gas or Btu's, but I am sure many will testify that the size of the undiscovered reserve of petroleum and natural gas is large—perhaps beyond belief."

The foregoing statement relating to the question of latent domestic resources was made by Frank A. Morgan, president of the American Association of Petroleum Geologists and vice president of Richfield Oil Corporation, in a discussion of "The Effort That Finds Oil" before the spring meeting of the American Petroleum Institute's Division of Production in Los Angeles, California.

Whether we can continue to be self-sufficient in this vital resource is a moot question. It involves the problem of where to search for new reserves. Morgan thinks "we are too prone to want to look for oil where the other fellow thinks there is oil, too. If our reserves are to continue to grow, we can no longer enjoy this luxury. We must throw off the shackles of prejudice and recognize that we cannot condemn any sedimentary area because we don't know anything about it."

A note of warning was sounded. He observed that on several occasions in the past there was a tendency to live "on our fat," especially near the peak of a period of excess production. This tendency, it was observed, precipitated an "inordinate discovery lag." So, "we must guard against those happenings in the future, caused either by our own frailties within the industry or by the government attempting to take over some phase of the exploration job for us."

Assuming that potential domestic oil reserves of great magnitude still remain to be discovered, the question arises in this time of national emergency whether the materials and manpower will be available to carry on drilling operations on a scale sufficient to do the job.

Tubular goods are at present in short supply. At the annual meeting of the American Iron and Steel Institute in New York in May, however, statements made by prominent steel executives of leading steel manufacturers lead to the belief that there is little or no shortage of steel; indeed that there may soon be an over supply. The shortage of tubular goods, however, arises in part from governmental allocations and in part from mill capacity being inadequate to supply all the necessary sizes needed by the petroleum industry.

To be self-sufficient in oil and with due cognizance of the international picture and national security, the domestic oil industry, given the materials and manpower, can be depended upon to do the job.—K. C. S.

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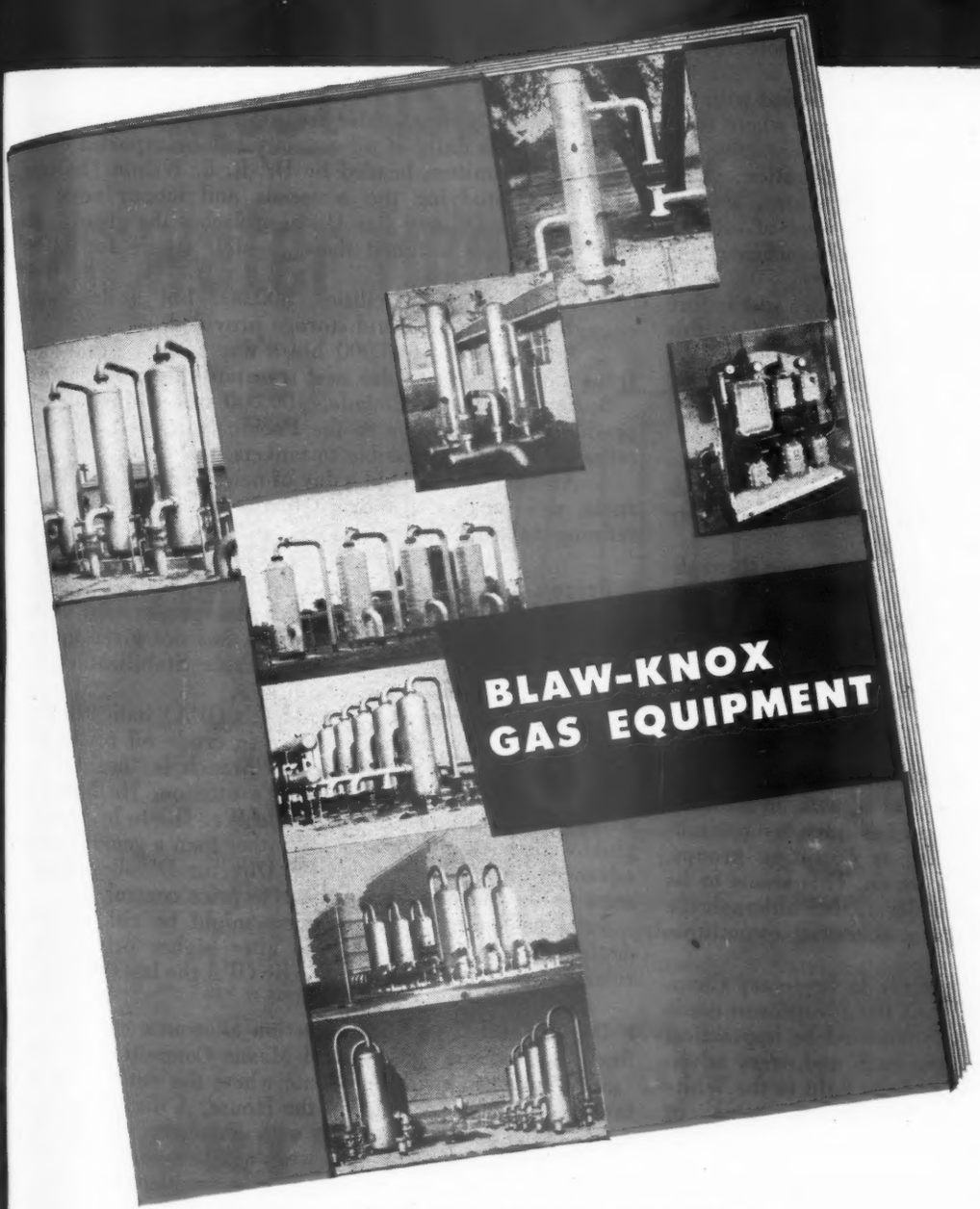

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Scanning WASHINGTON'S OIL HORIZON

Milburn Petty

WASHINGTON—The production branch will fare much better than the rest of the petroleum industry on steel during the third quarter.

The programs for oil country tubular goods and oil field machinery and equipment have been allotted 630,000 tons of steel, which is just about what the Petroleum Administration for Defense had asked for.

For the rest of the industry, including refining and transportation, PAD had put in requests totaling about 1,400,000 tons. Instead, PAD was given a lump sum of 963,000 tons, a cut of about 30 per cent. While not satisfied with the total amount, PAD will apportion this tonnage where most needed.

Officials of the Defense Production Administration, which makes the policy decisions on steel allocations, slashed PAD's requests despite warnings that rationing of oil and gas might result if petroleum supply proves insufficient due to lack of materials.

DPA officials indicated, at a press conference just before the allocations were made, that they were aware of this warning on the possibility of rationing but said "we have yet to see any convincing evidence that we are really pushed to that extent."

▸ **New Orders.** A series of orders is being worked up—to be issued by the National Production Authority but administered by the PAD—to carry out PAD's responsibility for "dividing up the pie" on steel.

One order will provide for priorities assistance throughout all branches of the oil and gas industries based on "relative essentiality" under PAD's overall supply program. Another will require prior approval from PAD for any new facilities costing over $5000. A third will set maximum inventories (probably 90-days supply) for oil and gas operators.

▸ **NPC.** It now appears likely that the National Petroleum Council will be allowed to continue, as is, with an industry man as the chairman. Other oil and gas advisory committees, particularly those functioning as operating groups, may have government men as chairmen. This seems to be the nature of the compromise now developing although the PAD still hopes to have all the non-operating committees headed by industry men.

This changed outlook is due mainly to Secretary Chapman coming to realize (1) how much the government needs these advisory committees and (2) it would be impractical to have a government man heading each and every advisory committee. So, Chapman carried the fight to the White House with the result that President Truman came out publicly for continuance of the NPC as is.

▸ **Tax Write-Offs.** PAD's recommendations as to the percentage of total cost entitled to accelerated tax amortization are intended "to permit recovery of initial investment under present tax conditions and price stabilization in the same number of years as would be required under pre-Korean conditions." Briefly, that is the basic yardstick.

Facilities with no post-emergency economic use—such as alkylation units—are allowed a rapid write-off for 100 per cent. Others include basic refinery units, natural gasoline plants, and tools, machinery and laboratory equipment, 75 per cent; utilities, 60 per cent; service facilities and storage and loading, 50 per cent; oil and gas pipe lines, 30 per cent; and office building, 15 per cent. Marketing facilities, production facilities, and production equipment are not entitled to accelerated amortization, PAD has ruled.

▸ **Tidelands.** A new stalemate looms on the tidelands leasing question. States righters in the House are getting set to push through some sort of quitclaimer. In the Senate, the quitclaimers may have a majority but they don't appear to have the necessary two-thirds to override a presidential veto.

▸ **Expansion.** Four possible areas to make up an additional million barrels daily of oil capacity will be reported on by the NPC committee, headed by Dr. R. E. Wilson (Indiana Standard), studying the materials and money costs involved, if the Oil and Gas Division flashes the green light. Dr. Wilson has outlined these possible stages for study, if OGD approves:

1. From existing facilities, 500,000 bbl a day, with enough transportation and storage provided.
2. An additional 300,000 bbl a day of new production from the Gulf Coast, plus new transportation.
3. From Alberta, Canada, 100,000 bbl a day of new production, a pipe line to the Pacific Northwest and new refinery capacity accessible to tankers.
4. Another 100,000 bbl a day of new production in Venezuela, new tankers to move it to the East Coast and new refining capacity there.

▸ **Prices.** The IPAA's committee studying the replacement cost of crude oil is going ahead with preparation of its report. This indicates that the IPAA has not given up the idea of petitioning the Office of Price Stabilization for higher crude prices.

Oil Price Stabilizer O. E. Judd (Ex-OPA) indicated that he is against any general increase in crude oil prices. Financial position of the production branch is "healthy" so no increase is warranted in Judd's opinion. He favors a stripper well subsidy—like in World War II—to bring marginal wells back into production rather than a general price advance. But Judd's boss, OPS Director DiSalle, doesn't seem to like the subsidy approach to price control.

Judd has hinted that producers might be risking their depletion allowance if they go after higher prices. This echoes a similar argument made by OPA the last time.

▸ **Depletion.** The oil-gas depletion allowance survived its first real test in the Ways and Means Committee but still faces a bitter fight in the Senate where the anti-oil bloc is larger—and louder—than in the House. A divide-and-conquer strategy is being used, with Treasury offering the full 27½ per cent to stripper wells and secondary recovery projects but only 15 per cent (plus a supplemental allowance based on actual wildcat expenditures) for all other operators.

▸ **TEL.** Independent refiners are still pressing PAD for a general revision of the tetraethyl lead allocation order to pull down octane ratings and shake loose more lead for the smaller companies. So far, PAD has stood pat, saying reports on June 1 octane ratings will show a drop of 1½ numbers on the average.

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HIGHLIGHTS IN OILDOM

URANIUM SEARCH URGED

The oil industry has been asked to extend its exploration to include a search for uranium, Dr. Phillip L. Merritt, assistant director of the Atomic Energy Commission's division of raw materials, has announced. Speaking before the American Association of Petroleum Geologists, he said the industry should carry some type of counter as essential equipment in all exploration parties, check sludges and cores of all drilling operations, and pool its geological knowledge with that of the AEC.

COAL VERSUS OIL

Harry J. Kennedy, vice president of Continental Oil Company, warned members of the Indiana Oil Jobbers Association recently that "John L. Lewis appears to be hand-in-glove with his employers in a scheme to take over your customers and sell them coal instead of oil." The coal industry is responsible for a proposed new national fuel policy "to be based upon governmental regimentation." The coal industry should spend its own money "into research and development of plants to convert coal—economically—in liquid fuels," Kennedy remarked.

SPREAD FREEDOM IDEA: GONZALES

America must make foreign nations understand that freedom is one of the three keys to economic progress, Dr. Richard J. Gonzales of Houston, Texas, Humble Oil and Refining Company, declared in a speech before the Society for the Advancement of Management in Dallas recently. The other two keys, Dr. Gonzales declared, are productive capital and mechanical energy. These are no good, he stressed, without a climate of freedom in which to put them to work. "We have a superb economic system," he exclaimed, "but we have done a lousy job in selling it."

GASOLINE TAXES CLIMB

North Dakota, South Dakota, Utah, and Wyoming have raised taxes on gasoline a penny a gallon, the Wall Street Journal reports. "Temporary" gasoline taxes in Kansas, Nevada, and Oklahoma have turned out to be not so temporary, as state legislatures have extended levies that were due to expire this year. Minnesota raised its tax on aviation gasoline to 5 cents a gallon, while New York raised levies on diesel fuel to 6 cents a gallon.

STORM WARNINGS AID DRILLERS

Warnings prepared through the combined use of weather forecasting, oceanography, and applied climatology are aiding workers on oil wells out in the Gulf of Mexico in reaching shore before approaching hurricanes. Oil well operators get an estimate of the amount of time it will take for the huge ocean swells that precede a hurricane to reach their wells. General hurricane forecasts did not give adequate time to secure drilling equipment, Karl Shisler, of an industrial firm that devised method, announced.

AID OF COLLEGE MEN SOUGHT

Standard Oil Company of New Jersey will soon employ 10 college professors and instructors to work with its administrative staffs for up to two years. Under a program designed to supplement the work of some of its executive personnel with special talents available in the educational field, Jersey Standard and its affiliated companies will seek the services of professors who can be released because of reduced enrollments.

MANPOWER SHORTAGE ALARMING

Huge expansion programs underway and proposed are causing the oil industry to view with concern the possibility of increased shortage of manpower in the future. A National Petroleum Council committee on manpower has recommended the oil and gas division of the Interior Department urge the Petroleum Administration for Defense to establish a unit to review requests for occupational deferment. It also suggested returning drafted employees after a specific period of time.

MEXICO MAKES OIL PAYMENT

A down payment has been made by Mexico on an American oil company it expropriated 13 years ago. General Antonio J. Bermudez, director general of Mexico's oil monoply, sent a check for $1,000,000 to the Mexican Gulf Oil Company and its subsidiaries, the Hamilton Devine and International Oil companies. The balance will be paid in 20 monthly installments, Bermudez announced. This was one of 11 U. S. and British oil companies expropriated in 1938.

OIIC GETS FREEDOM AWARDS

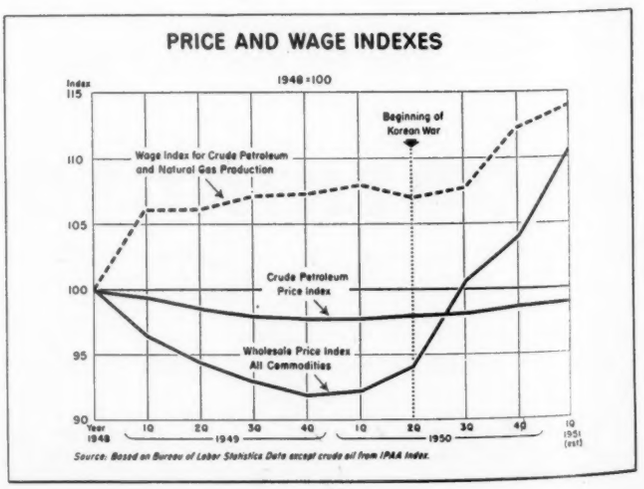
Two awards for "outstanding contributions to freedom during 1950" were presented to the Oil Industry Information Committee for its 1950 national advertising campaign and its 1950 motion picture, "24 Hours of Progress". The awards were made by Freedoms Foundation, Inc., at Columbia University. The ceremonies honored organizations and individuals in the New York area who had been given Foundation awards.

The OIIC awards were accepted by H. B. Miller, executive director of the group. They were presented by Kenneth D. Wells, executive vice president of the Foundation.

SPECIAL TAX BENEFITS DENOUNCED

The National Dixie Distributors want an end put to special advantages enjoyed by cooperative organizations. During its semi-annual meeting in Phoenix, Arizona, the association asked for equal taxation of all interests engaging in petroleum operations. The resolution urged Congress to impose equal taxation of all in the petroleum industry.

From Facts and Forecasts by the Independent Petroleum Association of America



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National Petroleum Situation

By H. J. STRUTH*

Import Rate. Imports of crude and products in the first 4 months of 1951 averaged about 942,000 bbl daily, against a daily average in the same period last year of 824,000 bbl. This is an increase over last year of 14 per cent, the same rate of increase experienced in the comparable period of 1950. The ratio of imports to total demand is 12.6 per cent, unchanged from a year ago. Crude oil imports this year have averaged 496,000 bbl daily, against 471,000 bbl daily last year. Crude imports now comprise 8.26 per cent of domestic production, compared with a ratio of 9.55 per cent last year.

Heavy Demand. Demand for all oils in the first 4 months of 1951 averaged about 7,633,000 bbl daily, marking an increase over last year of 11 per cent. This year's demand has thus far shown a gain over last year of 943,000 bbl daily. Demand in April was about 1,333,000 bbl daily greater than a year ago. Motor fuel demand is 13 per cent above last year, while fuel oil demand has been 15 per cent greater. Sharply increased refinery operations have increased the demand for crude oil by about 20 per cent. Refineries are currently running about 94 per cent domestic crude oil and about 6 per cent foreign crude.

Crude Stocks Rising. Stocks of crude oil increased about 5,300,000 bbl in April, and were estimated at a total of about 241,800,000 bbl on April 30. Substantial increases in domestic production, augmented by larger imports, are expected to effect further improvement in the crude stock situation during May. Stocks at the close of April were about 1 per cent lower than a year ago. From a supply viewpoint, however, they represented only 37 days supply, against 46 days supply a year ago. In relationship to daily demand, current crude stocks represent about 37 bbl, whereas 10 years ago the industry carried 73 bbl in storage for each barrel of daily crude demand.

Production Rise. Since December, national crude oil production has increased 417,000 bbl daily. Estimates for April indicate a daily production of 6,136,000 bbl, compared with a daily average in December of 5,719,000 bbl. Texas has accounted for a major share of the increase. Texas production in April was about 2,773,000 bbl daily, against a daily average in December of 2,410,000 bbl. National production in the first 4 months of 1951 was 22 per cent above last year, while Texas output increased about 35 per cent.

*Petroleum Consultant, Dallas, Texas

Comparative Statistics, April, 1951

*All figures are computed on a Bureau of Mines' Basis**

	April 1951Ⓟ	March 1951Ⓡ	April 1950	This Year to dateⓅ	Last Year to date	Per Cent change
Total supply,* all oils	227,929	232,709	189,719	899,403	748,074	+20
Daily average	7,598	7,507	6,324	7,495	6,234	
Total demand,‡ all oils	232,084	231,137	192,081	915,953	802,848	+11
Daily average	7,736	7,456	6,403	7,633	6,690	
Change in stocks	—4,155	+1,572	—2,362	—16,550	—54,770	
Crude supply*	199,110	202,550	164,388	779,379	648,479	+20
Daily average	6,637	6,534	5,480	6,495	5,404	
Crude demand‡	193,810	201,297	161,013	786,042	657,230	+20
Daily average	6,460	6,493	5,367	6,550	5,477	
Crude stocks	241,800	236,500	244,605	241,800	244,605	— 1
Days supply	37	36	46	37	46	
Natural gasoline production	16,400	17,100	13,999	66,427	57,250	+16
Daily average	547	552	467	554	477	
Motor fuel production	87,650	91,650	77,606	357,184	314,016	+14
Daily average	2,922	2,956	2,587	2,977	2,617	
Gasoline yield per cent	40.8	40.5	43.6	40.6	43.1	+ 2.5
Motor fuel demand‡	92,754	87,133	82,705	336,553	296,901	+13
Daily average	3,092	2,811	2,757	2,805	2,474	
Motor fuel stocks	136,800	141,900	127,534	136,800	127,534	+ 7
Days supply	44	50	46	44	46	
Fuel oil production	75,030	84,500	60,727	324,609	256,891	+26
Daily average	2,501	2,726	2,024	2,705	2,141	
Fuel oil demand‡	89,005	102,646	73,946	410,133	357,120	+15
Daily average	2,967	3,311	2,465	3,418	2,976	
Fuel oil stocks	80,550	82,050	77,509	80,550	77,509	+ 4
Days supply	27	25	31	27	31	
Refinery still runs	189,200	198,950	155,797	771,853	640,039	+21
Daily average	6,307	6,418	5,193	6,432	5,334	
Stocks, all oil	556,160	560,315	548,709	556,160	548,709	+ 1
Days supply	72	75	86	72	86	

Current Crude Oil Prices

U. S. average	$2.58	Louisiana	$2.62	Basic crude prices:	
Texas	2.61	Arkansas	2.43	Oklahoma-Kansas (36 gr.)	$2.57
California	2.42	New Mexico	2.40	Texas Gulf Coast (36 gr.)	2.80
Oklahoma	2.62	Mississippi	2.23	East Texas	2.65
Kansas	2.62	Illinois	2.76	West Texas (36 gr.)	2.44
		Other states	2.60	California Signal Hill (26 gr.)	2.31
				Pennsylvania, Bradford	4.25

Drilling and Production Statistics

	April 1951Ⓟ	March 1951Ⓡ	April 1950	This Year to dateⓅ	Last Year to date	Per Cent change
Wells drilling	4,975	4,860	4,390	4,975	4,390	+13
Total wells drilled	3,319	3,110	3,209	12,734	12,467	+ 2
Development wells	2,477	2,372	2,550	9,778	9,921	— 1
Oil	1,676	1,604	1,826	6,596	6,922	— 5
Gas	139	192	168	730	728	
Dry	662	576	556	2,452	2,271	+ 8
Per cent dry	26.7	25.3	21.8	25.1	22.9	+ 2.2
Service wells	48	57	60	197	279	—29
Wildcat wells	794	681	599	2,759	2,267	+22
Oil	123	117	86	458	336	+36
Gas	18	26	11	84	68	+24
Dry	653	538	502	2,217	1,863	+19
Per cent dry	82.2	79.0	83.8	80.4	82.1	— 1.7

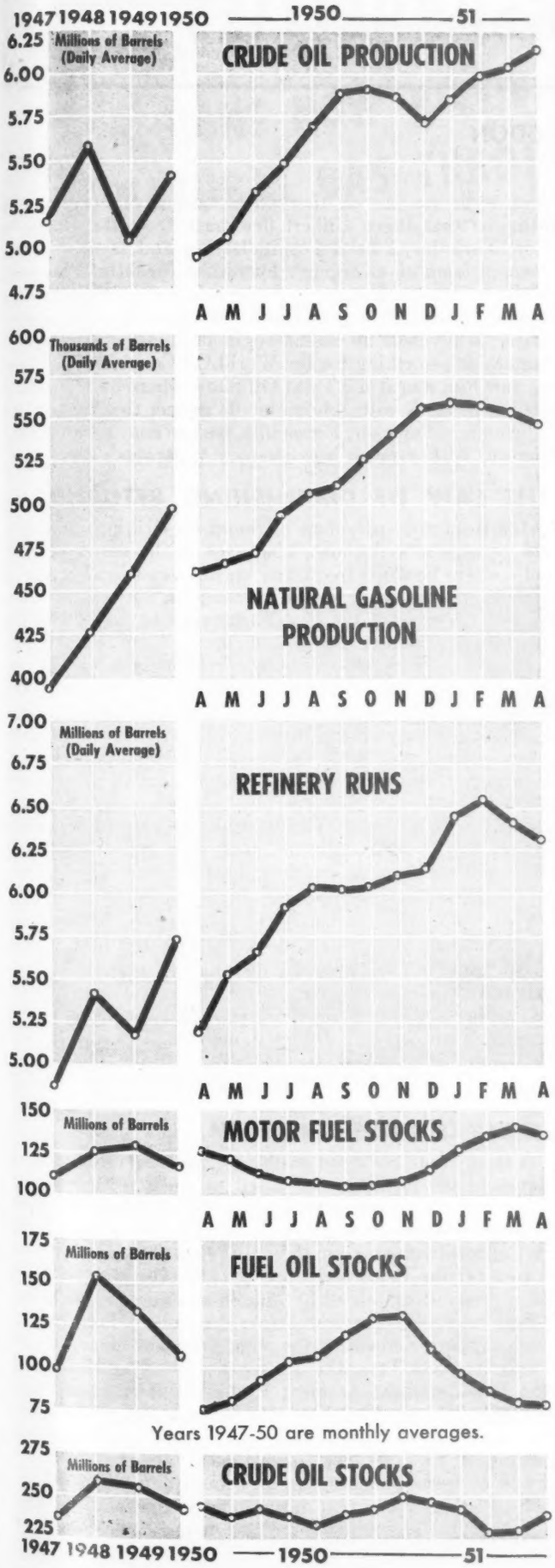
By State

Wells drilled (excl. service)	3,271	3,053	3,149	12,537	12,188	+ 3
Arkansas	37	25	34	131	121	+ 8
California	177	162	134	629	546	+15
Illinois	114	70	157	502	663	—24
Kansas	355	319	287	1,336	1,091	+22
Louisiana	157	166	194	649	771	—16
Mississippi	23	20	36	77	109	—29
New Mexico	52	43	49	199	220	—10
Oklahoma	478	418	458	1,750	1,608	+ 9
Texas	1,341	1,335	1,330	5,242	5,109	+ 3
Other states	537	495	470	2,022	1,950	+ 4
Wildcats drilled	794	681	599	2,759	2,267	+22
Arkansas	12	5	7	30	31	— 3
California	41	39	27	148	118	+25
Illinois	25	19	50	101	178	—43
Kansas	96	64	50	315	189	+67
Louisiana	22	29	25	104	92	+13
Mississippi	10	8	19	36	47	—23
New Mexico	7	9	4	34	26	+31
Oklahoma	95	67	63	320	269	+19
Texas	347	337	265	1,256	1,016	+24
Other states	139	104	89	415	301	+38
Daily crude production	6,136	6,018	4,968	5,998	4,933	+22
Arkansas	82	80	85	81	85	— 5
California	962	960	858	961	861	+12
Illinois	153	166	168	160	170	— 6
Kansas	328	311	282	313	281	+11
Louisiana	632	648	518	633	544	+16
Mississippi	101	103	98	103	99	+ 4
New Mexico	145	142	125	140	128	+ 9
Oklahoma	500	500	417	498	406	+23
Texas	2,773	2,650	2,014	2,650	1,956	+35
Wyoming	190	200	155	192	156	+23
Other states	270	258	248	267	247	+ 8

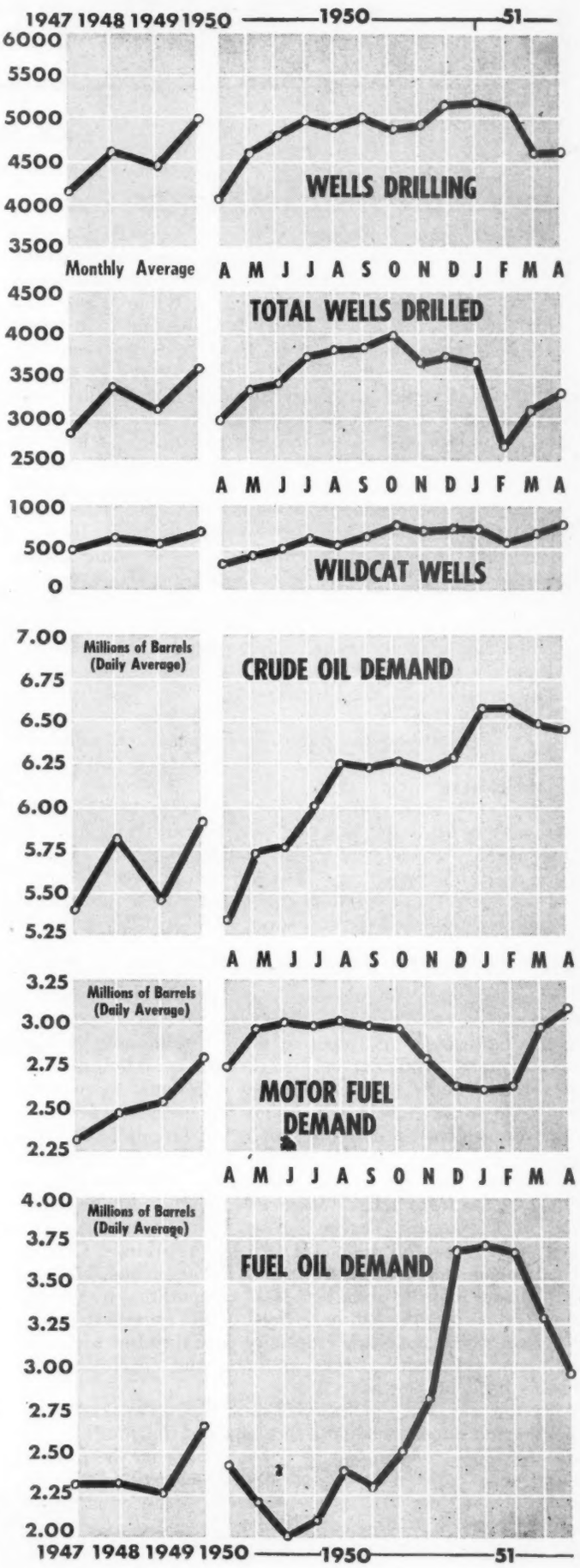
* Unless otherwise stated all figures represent thousands of barrels. ‡ Total demand, including exports. * Includes domestic production and imports. Ⓟ Preliminary. Ⓡ Revised.

Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.

National Petroleum Situation


1947 1948 1949 1950 —1950— 51
Millions of Barrels (Daily Average)
6.25 6.00 5.75 5.50 5.25 5.00 4.75
CRUDE OIL PRODUCTION
A M J J A S O N D J F M A
Thousands of Barrels (Daily Average)
600 575 550 525 500 475 450 425 400
NATURAL GASOLINE PRODUCTION
A M J J A S O N D J F M A
Millions of Barrels (Daily Average)
7.00 6.75 6.50 6.25 6.00 5.75 5.50 5.25 5.00
REFINERY RUNS
A M J J A S O N D J F M A
Millions of Barrels
150 125 100
MOTOR FUEL STOCKS
A M J J A S O N D J F M A
Millions of Barrels
175 150 125 100 75
FUEL OIL STOCKS
Millions of Barrels
275 250 225
CRUDE OIL STOCKS
1947 1948 1949 1950 —1950— 51

Years 1947-50 are monthly averages.


1947 1948 1949 1950 —1950— 51
6000 5500 5000 4500 4000 3500
WELLS DRILLING
Monthly Average
A M J J A S O N D J F M A
4500 4000 3500 3000 2500
TOTAL WELLS DRILLED
A M J J A S O N D J F M A
1000 500 0
WILDCAT WELLS
Millions of Barrels (Daily Average)
7.00 6.75 6.50 6.25 6.00 5.75 5.50 5.25
CRUDE OIL DEMAND
A M J J A S O N D J F M A
Millions of Barrels (Daily Average)
3.25 3.00 2.75 2.50 2.25
MOTOR FUEL DEMAND
A M J J A S O N D J F M A
Millions of Barrels (Daily Average)
4.00 3.75 3.50 3.25 3.00 2.75 2.50 2.25 2.00
FUEL OIL DEMAND
1947 1948 1949 1950 —1950— 51

PETROLIC PERSONALITIES

DICK SNEDDON

NEWS FROM THE GREAT WHITE WAY

To our inexpressible joy we have just received a communique from O. W. "Ox" Morgan, the Byron-Jackson behemoth who went New York on us a while ago and is now the idol of the tea set along the Great White Way. "The body", as he is sometimes known back here in what might be termed the occidental area of the U.S., has a keen nose for the Cholly Knickerbocker type of news and he tells us that the winter season recently closed was marked by some scintillating soirees. In fact, to put it in his own colorful words, the comings and goings of California vips kept the upper crust of Nieu Amsterdam in a constant twitter. Among the interesting sun-tan folk who loitered engagingly in the skyscraper community was Al Collins, the Shell purchasing chap, still hobbling on a weak ankle. It is reported that Al acquired the charley horse in Ventura when he absent-mindedly walked down some stairs that weren't there. Our operative, on the other hand, swears that the injury was incurred in a cribbage game with Johnny Landers and was the result of over-pegging.

Another purchasing biggie whose presence occasioned no slight tremor in the breasts of the effete Manhattanites was Charlie Perkins, ex-Big Shot of the Nineteeners, now deputizing as manager of purchases for Union Oil Company while Buck Weaver lends his talent to the Air Force. Charlie is a southpaw divot lofter of astonishing persistence. He once belabored an unplayable lie so long and so violently that he dug up a 500 year old oak tree with a seven iron, and we have it on good authority that at the Rio Hondo Country Club, which was formerly an orchard, he came within a stroke of winning a company golf tournament although he finished the last seven holes with a crabapple.

THE GILBERTS POP IN FROM THE HAGUE

Another chap who whizzed in and out of the eager east not too long ago was Jack Pike, the perennially youthful looking president of Republic Supply Company. Jack is also a pretty proficient performer with a niblick and believes profoundly in the adage that it is better to swat the pill than to swallow it. He lashes the greensward with a rare discrimination, confining his attack largely to the area in the immediate vicinity of the ball, an unusual thing among the devotees of the soaring-sod practice. Charley Wagner, the front half of Wagner Morehouse, was reported by Bill Clarke, the Texaco tycoon, to be in the Big City too not long ago on some sort of a business binge. Charley is one of the ten best dressed men in the equipment business and always looks as if he had just been outfitted by Oviatts for a safari into the Biltmore Bowl or the Cocoanut Grove. We understand that he is especially partial to ties with dots in them, suits with stripes in them, and envelopes with checks in them.

By the way, our old friend, Frank Bergeron, the Baash-Ross export expert has had a short spell of indisposition but we are happy to state that he is again back on the track—to stay, we hope. We would caution Frank not to take the diagnosis of these M.D.'s too seriously—we knew a doctor in our younger days who treated a patient for two years for jaundice and then found out that the guy was a Jap. And while we are on the subject of convalescence, it is rumored that Helen Gilbert flew back from the Hague to New York for a brief hospitalization and is now all recovered from an emergency operation. Meantime, husband Wally took a quick jaunt to Venezuela and by the time this shows up in print they will both have flown back to Hague, where Wally will no doubt begin building a stereoscopic camera or something for the World Oil Congress. Last time we saw him was at the Tulsa Oil Show where he was taking double pictures with a home made gadget that looked like a juvenile cat cracker. Personally, we can conjure up double pictures with a much less complex apparatus.

THE LAW OF DIMINISHING RETURNS

Joe Robinson, president of Santa Fe Drilling Company, has become a well known character in the eastern metropolis where he stops frequently on his way to and from the various world enterprises of his concern. Perhaps it would be only fair to warn the New Yorkers not to tangle with Joe in any game involving the theory of probabilities. All they are likely to garner in any such exercise is a more intimate acquaintance with the law of diminishing returns. Ned Brown, the much traveled prexy of Brown Drilling Company, halted long enough in the Big City recently to make a few phone calls. Then, like one of these genies he was off in a puff of smoke to some outpost of civilization where his boys are in the process of planting a little slice of America and coincidentally building up a backlog of adventure stories to tell their children when they return and their children's children when they have reached what Victor Hugo called "the youth of old age."

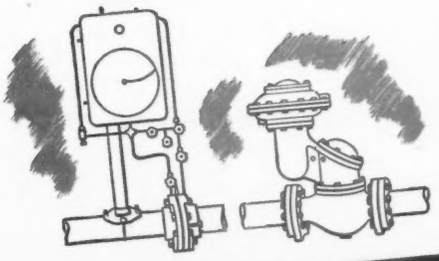
Last among the notables to be seen ambling along Forty Second Street and other famed metropolitan byways was R. M. "Bob" Cook, the husky Coaling boy who could probably have made a champ heavyweight boxer or a wrestler if he had been caught younger. Anyway, he has the torso and general sturdiness of Jimmy Londos. Bob is Strata Seal chief for Great Lakes Carbon Company out on the west coast and he seems to be mighty happy with his assignment.

FOOTBALL POST MORTEM

A flock of old Stanford grads foregathered at the Morgan Manse in the beginning of April to see a motion picture of last fall's big game between the Palo Alto lads and their rivals from over Berkeley way. Someone forgot to invite the California alumni and the only representative who came to root for the Bears was burly Jack Berlin who, however, did a pretty stout job all by himself of defending his team.

Besides, California having won the game didn't need too much support. Screaming for Stanford were Bill and Peggy Clarke and son Tom, the Texaco people; Jim Meade and Don Buterbaugh of Aramco; Frank McIntyre of Cal-Tex; and, of course, the Morgans—Ox, Juanita, Robin, and Kent. The report is that Robin and Kent are becoming thoroughly acclimated to their new environment and have already picked up quite a smattering of Brooklynese. Kent has developed into a real expert at scooping in the calories—with or without the help of cutlery—and there is little doubt that another hotshot football tackle is in the making.

SOME EASTERN SEABOARD REGIONS NOW RECEIVING NATURAL GAS THROUGH AMERICAN METER COMPANY EQUIPMENT



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CONVERSATION AND CONCORD JUICE

It is expected that over 1000 oil men, a large proportion of them real old timers in the game, will assemble at Steckel Park, Santa Paula, California, for the spring barbecue of the Petroleum Production Pioneers, which will be a matter of history before this appears in print. Ben Anderson of Continental Oil Company is sergeant-at-arms this year; Earl Daniels, the Hydril chap, is chairman of arrangements; and what they have arranged between them is just slightly less than terrific. Attending to all the details of the feast, which is a major feature of these outings, is Fritz Huntsinger of Ventura Tool Company, George Ruggels of C.C.M.O. Company, and a capable corps of aides.

These Ventura lads are experienced organizers as well as barbecuists and merely need to be left alone to come up with a far nicer mess of pottage than the one for which Esau traded his birthright. The dispensing of the burbling waters is now in charge of Hudson Drake, purchasing agent of the Belridge Oil Company, a lovely dispenser if we ever saw one. Hud and his assistants are a colorful lot who serve conversation and concord extract with equal finesse and generosity. They constitute a right important part of the meetings and contribute no end to the overall enjoyment. Leading the old timers at this particular gathering will be R. A. Broomfield, honorary president of the Pioneers, and retired president of Barnsdall Oil; and A. E. Fowks, former Union Oil executive, and honorary vice president of the organization.

LOWDOWN ON A HIGHERUP

Frank Martin Porter, president of the American Petroleum Institute and president of the Fain-Porter Drilling Company, Oklahoma City, Oklahoma, is a rather placid appearing gentleman who has every right to look quite the reverse. He has had more than the normal quota of distress and disappointment during his lifetime and anyone who knows a little of the multifarious and ramified activities of the API will find it easy to agree that he is not exactly reclining at this moment. He has weathered at least one financial crisis and has been stunned by the sudden demise of business partners, associates, and advisors. Indeed, on numerous occasions he has fought back to success from misfortunes that would have badly discouraged one with less fortitude. He is a native of that ebullient bailiwick, Brooklyn, but has none of the characteristics with which the stage version of the Brooklynite is usually invested.

He is somewhat reserved, almost seems bashful at times, but has plenty of strength when it becomes necessary to contest obstinacy with reason. He is well informed on the oil business in all its phases after 32 years of extensive experience and study and has the ability to transmit his own understanding to others with remarkable lucidity. We have watched him at close quarters fencing with the press and have admired both his clarity and his good humor. His diction is clear, his deliberations are precise, and his answers are never evasive. He certainly has the blending of qualities that is ordinarily associated with leadership and his elevation to the highest office in such a great national institution as the API is evidence that his leadership is recognized and appreciated.

A BOOSTER FOR TAXCO

A brief note from Bart Gillespie, the Marco Polo of the 20th Century, indicates that he resigned from CIMA at the end of January and with Mrs. Gillespie enjoyed the first vacation they have had in ten years. They flew back to St. Louis first to take in the AIME meeting there, then visited Seabee friends in Ohio, after which they had a nice stay with Admiral Ben Moreell and Mrs. Moreell at Pittsburgh. They wound up with a week of sight-seeing in Washington, D.C. and are now back in Mexico City feeling both refreshed and relaxed. Bart recently made a quick reconnaissance flight to Peru, which he hopes may develop a new assignment that will keep him in Mexico City for some time. We once asked Bart, who has been everywhere, what would be his choice of a place to live if he really wanted to settle down and enjoy himself on a fairly limited budget. Without hesitation he replied, "Taxco", so we are now saving our coupons in the hope that we may some day be able to check on his judgment. Incidentally, there are few people in the petroleum industry so widely known and so universally well regarded as Bart. Whether in foreign fields or on the home oil front he is hailed with genuine pleasure wherever he appears. He is one of the few honorary members of Nomads and no one was ever more deserving of the distinction.

CHICAGO NIMROD OFF TO BRAZIL

Leon Duane, the toolpusher with the two front names, has just completed a lengthy tour with Drillex in Los Blancos,, Argentina. He is reputed to have accepted a transfer to Brazil, and will probably be there before this gets into print. He is another chap who has certainly been around. He was born in the Illinois village that was once destroyed by Mrs. O'Leary's cow, but abandoned it for the Pacific Coast in 1921. Out here he began his petrolic career in the producing department of the Pan American Oil Company but later switched and for the past 20 years has devoted himself to drilling. A considerable portion of that time has been spent in the South American republics, particularly with Drillex in Paraguay, Shell in Trinidad, Socony in Venezuela, and the Argentinian service already mentioned. Leon has no family but maintains a home in Long Beach, at which with Mrs. Duane he spends as much vacation time as he can muster. For diversion there is nothing that appeals to him more than a hunting or fishing trip with a band of congenial souls who will hurry, and get the hunting or fishing over and gather around the campfire for a good hot helping of pork and beans and a well prolonged gabfest.

On the Oil Front

"SOME JOKER SWITCHED MY ROADMAP TO A PIPELINE MAP!"

DATA ON IMPORTANT OIL FIELDS OF THE UNITED STATES

(Continued from last month)

No.	Year discovered	Field	County	Producing formation	Gravity °API	Productive acres	Estimated average thickness (feet)
		Coastal District					
41	1928	Elwood	Santa Barbara	Monterey, Mio. Vaqueros, Sespe; Olig	33.7	350	330
42	1931	Gato Ridge	Santa Barbara	Sisquoc, Monterey; Mio	13.9	460	Fis
43	1903	Lompoc	Santa Barbara	Sisquoc, Monterrey; Mio	20.5	1,600	Fis
44	1937	Newhall-Potrero	Los Angeles	Modelo; Mio	33.0-36.0	640	300
45	1903	Orcutt	Santa Barbara	Sisquoc, Monterey; Mio	22.6	3,750	Fis
46	1927	Rincon	Ventura	Pico, Repetto; Pli	30.0	530	140
47	1930	San Miguelito	Ventura	Pico, Repetto; Pli	30.0	400	680
48	1934	Santa Maria Valley	Santa Barbara	Monterey; Mio	15.9	5,600	Fis
49	1911	Shiells Canyon	Ventura	Sespe; Olig	33.0	650	640
50	1916	South Mountain	Ventura	Sespe; Olig	23.9	600	950
51	1916	Ventura Avenue	Ventura	Pico, Repetto; Pli	30.0	2,400	Fis
		Los Angeles Basin					
52	1931	Alamitos Heights	Los Angeles	Pico, Repetto; Pli. Puente; Mio	26.8	75	250
53	1885	Brea Olinda	Orange	Repetto, Puente; Pli, Mio	22.5	1,165	800
54	1911	Coyote, East	Orange	Repetto, Puente; Pli, Mio	25.0	960	150
55	1909	Coyote, West	Orange	Repetto; Pli	29.0	850	473
56	1923	Dominguez	Los Angeles	Repetto; Pli. Puente; Mio	30.4	1,100	1,500
57	1935	El Segundo	Los Angeles	Puente, Mio. Franiscan; Jur	21.8	350	50
58	1920	Huntington Beach (Old and New)	Orange	Pico, Repetto; Pli. Puente; Mio	23.5	3,420	1,200
59	1924	Inglewood	Los Angeles	Pico, Repetto; Pli. Puente; Mio	22.0-32.0	780	975
60	1921	Long Beach	Los Angeles	Pico, Repetto; Pli. Puente; Mio	25.0	1,480	1,650
61	1890	Los Angeles District	Los Angeles	Repetto; Pli. Puente; Mio	13.7	1,500	9–20
62	1892	Montebello	Los Angeles	Repetto; Pli. Puente; Mio	25.0-30.0	2,060	800
63	1929	Playa Del Rey	Los Angeles	Repetto, Puente, Franciscan; Pli, Mio, Jur	21.0	400	20
64	1919	Richfield	Orange	Puente; Mio	20.5	1,100	510
65	1924	Rosecrans-Athens	Los Angeles	Repetto; Pli. Puente; Mio	33.0	600	1,050
66	1919	Santa Fe Springs	Los Angeles	Repetto; Pli. Puente; Mio	32.5	900	1,360
67	1926	Seal Beach	Los Angeles	Repetto; Pli. Puente; Mio	25.0	800	350
68	1922	Torrance-Hermosa	Los Angeles	Puente; Mio	22.0	5,000	120
69	1898	Whittier	Los Angeles	Repetto; Pli. Puente; Mio	19.0	500	270
70	1936	Wilmington	Los Angeles	Repetto, Puente; Pli, Mio. Franciscan; Jur	13.0-32.0	5,950	380
				COLORADO			
1	1863, 76	Florence	Fremont	Pierre; Cre U	31.0	9,000	—
2	1925	Iles	Moffat	Entrada, Mancos, Morrison; Jur, Cre U	32.0	600	40–24
3	1926	McCallum, North	Jackson	Dakota; Cre U	46.0	1,600	30–65
4	1924	Moffat (Hamilton)	Moffat	Sundance; Jur. Dakota; Cre U	39.0	240	16
5	1935	Price (Gramps)	Archuleta	Dakota, Morrison; Cre U	32.0	320	70
6	1933	Rangely, Deep	Rio Blanco	Weber; Pen	33.0	20,000	200
7	1902	Rangely, Shallow	Rio Blanco	Mancos, Dakota, Rio Blanco	41.0	2,760	Var
8	1923	Wellington	Larimer	Dakota; Cre U	33.0	1,600	30
9	1938	Wilson Creek	Rio Blanco	Morrison, Sundance	48.0	2,305	20–80
				ILLINOIS			
1	1938	Aden Consol	Wayne, Hamilton	Aux Vases, McClosky, O'Hara Rosiclare; Miss. U & L	38.5	2,200	8
2	1940	Alboin, Consol	Edwards	Bridel Point; Pen. Bethel; Miss. McClosky; Miss. L & U	29.6-40.0	3,360	12
3	1912, 41	Allendale	Wabash, Lawrence	Biehl, McClosky; Pen. Bethel; Miss. U & L	35.1	2,700	15
4	1941	Benton	Franklin	Tar Springs; Miss U	41.6	2,400	34
5	1942	Bible Grove	Clay, Effingham	Cypress, Rosiclare, McClosky	38.0	4,300	12
6	1940	Boos, North	Jasper	Rosiclare, McClosky; Miss. L	38.6	1,580	9
7	1944	Boyd	Jefferson	Bethel, Aux Vases, O'Hara; Miss	37.6	1,320	14
8	1938	Boyleston Consol	Wayne	Aux Vases, Lower O'Hara, Rosiclare, McClosky; Miss. L&U	40.0	4,820	7
9	1937	Centralia	Clinton, Marion	Cypress, Bethel, Trenton; Ord, Dev	36.0-43.0	3,560	12
10	1937	Cisne	Wayne	Aux Vases, Rosiclare, McClosky	35.8-38.5	1,140	10
11	1937	Clay City Consol	Clay, Wayne	Cypress, Bethel, Aux Vases, Rosiclare, McClosky	38.2	23,100	12
12	1939	Cordes	Washington	Bethel; Miss. U	37.4	1,500	14
13	1940	Dale-Hoodville	Hamilton	Tar Springs, Cypress, Benoist, Aux Vases, O'Hara, McClosky	38.0	5,080	19
14	1944	Devide, West	Jefferson	L O'Hara, Rosiclare, McClosky	39.6	920	12
15	1938	Dix	Jefferson	Bethel, Rosiclare; Miss. L & U	39.0	1,700	13
16	1939	Dundas, Consol	Richland, Jasper	Cypress, Aux Vases, Rosiclare, McClosky; Miss. L & U	38.0	9,000	8
17	1941*	Inman, East	Gallatin	Tar Springs, Pennsylvania; Pen Cypress, Waltersburg; Miss. U	35.0	1,0 0	15

*Abandoned in 1940; revived in 1941.

DATA ON IMPORTANT OIL FIELDS OF THE UNITED STATES

No.	Annual production (thousands of barrels)						Cumulative production thru 1947 (M bbl)	Estimated recovery per acre (bbl)	Number wells producing		
	1942	1943	1944	1945	1946	1947			Total	Flowing	Pumping
		Coastal District					**CALIFORNIA**				
41	876	1,690	2,129	2,174	2,454	2,576	80,315	222,111	73	—	—
42	1,214	1,301	1,770	1,610	1,421	1,314	14,210	28,035	39	—	—
43	418	598	644	551	537	1,660	14,601	8,088	73	—	—
44	1,307	1,963	1,894	1,995	2,111	2,397	13,976	18,092	55	—	—
45	1,166	1,472	1,559	1,331	1,308	1,636	105,833	27,786	—	—	—
46	1,007	1,212	1,502	1,683	1,627	1,344	22,459	39,840	100	—	—
47	1,220	1,591	2,091	1,917	1,835	1,774	16,296	36,305	51	—	—
48	7,523	8,268	11,306	13,419	11,929	9,518	84,111	13,320	477	—	—
49	334	309	567	625	457	385	13,210	19,731	143	—	—
50	537	525	560	806	1,296	1,857*	28,262*	44,008	134	—	—
51	13,652	15,489	17,487	17,695	16,908	17,754	337,868	133,381	589	—	—
		Los Angeles Basin									
52	322	280	257	233	211	—	—	339,253	—	—	—
53	3,408	4,248	4,270	4,177	3,946	4,449	192,489	161,579	381	—	—
54	2,037	2,055	1,972	1,831	1,741	1,760	54,991	55,449	173	—	—
55	7,783	4,421	4,433	5,259	5,574	5,513	154,430	175,196	227	—	—
56	7,920	9,123	7,872	6,729	5,866	5,436	173,203	152,515	338	—	—
57	424	363	330	287	205	165	11,910	33,557	—	—	—
58	11,980	13,217	17,141	17,584	17,082	18,313	396,328	110,531	984	—	—
59	6,742	6,909	6,460	5,621	4,721	4,330	160,477	200,188	313	—	—
60	12,978	11,552	10,792	9,779	9,055	8,596	726,416	485,014	1,110	—	—
61	191	178	183	182	149	56	66,971	44,610	80	—	—
62	3,925	3,964	3,904	3,647	3,129	2,696	148,514	70,785	327	—	—
63	1,197	960	947	899	850	757	53,097	130,850	116	—	—
64	2,751	2,517	2,411	2,597	2,595	2,413	107,347	95,395	311	—	—
65	2,700	2,192	2,234	2,082	1,840	1,684	60,915	98,718	180	—	—
66	7,756	7,303	6,831	6,277	6,117	5,914	517,373	568,288	542	—	—
67	2,695	2,586	2,566	3,185	3,482	4,042	84,252	100,263	180	—	—
68	2,993	2,832	3,180	3,232	3,126	2,938	122,525	23,917	725	—	—
69	378	376	383	367	373	359	20,655	40,592	155	—	—
70	33,447	34,360	36,765	36,145	40,171	47,674	368,584	53,934	1,873	—	—
							COLORADO				
1	49	21	44	41	29	25	13,963	1,549	72	0	72
2	537	483	456	427	453	542	11,979	19,062	—	—	—
3	—	—	59	167	207	190	734	321	4	4	0
4	121	127	114	104	93	93	6,444	26,463	11	0	11
5	440	251	225	200	195	193	2,820	8,209	16	0	16
6	6	14	103	1,357	7,821	11,264	20,563	465	349	223	126
7	301	297	290	213	317	350	2,754	871	48	0	48
8	81	74	64	121	101	101	5,454	3,346	—	—	—
9	534	760	1,400	2,054	2,382	2,707	10,711	3,472	30	11	19
							ILLINOIS				
1	413	596	537	390	355	244	5,412	2,349	81	0	81
2	501	371	818	1,302	890	665	6,391	1,704	—	—	—
3	424	809	800	657	545	617	8,958	3,089	310	0	310
4	5,386	2,334	1,558	1,148	1,087	781	19,284	7,710	—	—	—
5	290	749	1,049	1,757	1,608	1,055	6,509	1,268	187	0	187
6	654	596	227	253	437	322	3,485	2,002	57	0	57
7	0	0	157	1,362	1,561	1,315	4,395	2,333	—	—	—
8	672	461	1,015	609	479	401	8,068	1,589	—	—	—
9	2,262	1,706	1,740	1,827	1,868	1,462	30,964	8,287	—	—	—
10	180	157	122	117	260	200	3,490	2,991	51	0	51
11	2,752	2,811	5,111	5,065	5,147	4,387	50,472	1,995	—	—	—
12	437	383	344	282	270	241	3,681	2,293	124	0	124
13	5,273	3,882	3,132	2,039	1,488	1,347	24,115	4,482	—	—	—
14	0	0	67	1,074	691	234	2,066	1,991	43	0	43
15	651	530	509	565	415	435	5,366	2,901	—	—	—
16	2,353	964	665	592	554	661	12,869	1,356	245	0	245
17	526	710	868	544	462	351	3,917	3,302	—	—	—

n Rotary Hose History!

The Great New U.S. ROYAL 4

Never Before—Such Safety and Service in a Rotary Hose

From Gulf off-shore rigs and those along its coasts . . . from deepest fields of East and West Texas, Louisiana and Oklahoma . . . come the fabulous reports of Royal 4 performance. Two long years of extensive test and experiment with many service lengths for every type rig . . . have produced success stories of continuous safety and trouble-free service—such as have never been told before.

FIRST ROTARY HOSE EVER WITH . . .

- **Double Reinforcing Wire Units** —Royal 4 incorporates 2 double wire layers (4 stress wires in all) —each layer with sufficient hydrostatic value to resist bursting should the other become damaged—each a hose in itself.
- **Highest Working Pressure** —rules out all "burst" risk from the greater pressures of the newest pumps —introduces a new standard of safety to rotary hose operation—eliminates costly switching to steel hose when high pump pressures are required.
- **Ultra-Flexibility** —as conclusively demonstrated by rigorous factory "sling" tests—U. S. Royal 4 brings to rotary hose operations a far superior flexibility—as a result of its unique wire-reinforced cotton-and-fabric construction.
- **Complete Kink Resistance** —with extreme flexibility from leakproof coupling to leakproof coupling—Royal 4, even on mast type rigs, resists all forms of kinking throughout its working length.

THE NEW IMPROVED U. S. MATCHLESS CABLE-LAY

Product of exhaustive laboratory tests involving cable wire sizes, strand numbers and degrees of flexibility . . .

Performance-tried and proved to add miles of drilled footage to service life . . .

Now, here is U. S. Rubber's reply to oil industry requests for a better cable-reinforced hose. Here is U. S. Matchless Cable-Lay . . . with 19-strand, *twist-free* cable wire in rubber-cushioned plies . . . with a flexible, yet firm carcass of special cotton fabric . . . ready to demonstrate its longer life of increased flexibility and kink-resistance.

Expert advice and service on the job are yours for the asking. See your "U. S." Distributor about these great new hose or write . . .

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LETTERS *to the* EDITORS

"THAT'S RIGHT" SAY THE LETTERS ABOUT "WHAT'S WRONG . . ."

To The Petroleum Engineer:

I wish to compliment you on the article appearing in the April issue. It tells the story in a concise and forceful manner.

Our Department of Information advises me that they have secured permission to use this material throughout the country.

Frank M. Porter

President
American Petroleum Institute
New York, New York

To The Petroleum Engineer:

I want to compliment you on the forthright manner in which you treated the article "What's Wrong With Being an Oil Company?". It is this type of straightforward thinking and talking that is so greatly needed by the industry at this time. I, for one, greatly appreciate it.

Russell B. Brown

Independent Petroleum Association of America
Washington, D.C.

To The Petroleum Engineer:

As state chairman for Oil Industry Information Committee I would like to mimeograph for distribution your article, "What's Wrong With Being an Oil Company?". May I have your permission?

R. M. Stephens

Humble Oil & Refining Company
Houston, Texas

To The Petroleum Engineer:

The article, "What's Wrong With Being an Oil Company?" by Ernestine Adams, has caused a great deal of comment, as you no doubt know. It is the kind of reading that people like and I hope Ernestine Adams will continue with this kind of constructive contribution to our industry. The trouble with most of our articles and speeches is for one reason or another they fail to catch the public's fancy, but this article really hit the nail on the head.

I wish you would congratulate the author for me.

John M. Lovejoy

President
Seaboard Oil Company of Delaware
New York, New York

To The Petroleum Engineer:

Miss Adams' article, "What's Wrong With Being an Oil Company?", expresses some thoughts that are on all of our minds. I hope you will continue the good work of your magazine in this field, and if possible find means of carrying your message to those outside the oil industry and the oil regions.

B. B. Jennings

President
Socony-Vacuum Oil Company
New York, New York

To The Petroleum Engineer:

Your article, "What's Wrong With Being an Oil Company?" which appeared in your April issue is one of the best I have read in defense of the oil industry.

In fact, we were so impressed by it that we would like to request permission to reprint it in pamphlet form for distribution to all our employees and business contacts.

Jack F. Gow

Tide Water Associated Oil Company
New York, New York

To The Petroleum Engineer:

The article is excellently done, and it is a fine contribution to the free enterprise system from the oil man's view point.

B. A. Hardey

Shreveport, Louisiana

To The Petroleum Engineer:

I have received the article, "What's Wrong With Being an Oil Company?" and read it with a great deal of interest. I wish to commend you for having it reprinted.

Clint W. Murchison

Dallas, Texas

To The Petroleum Engineer:

At your convenience, I shall appreciate your sending me 100 reprints of the article, "What's Wrong With Being an Oil Company?". I found the article most interesting and I believe the dissemination I plan to make of it will be helpful to the industry.

Harry Moreland

President
Great Lakes Pipe Line Company
Kansas City, Missouri

To The Petroleum Engineer:

I like your article, "What's Wrong With Being an Oil Company?", a reprint of which reached me via the API. I would like to reprint this copyrighted article as a feature in my Automotive Dealer News, oil marketing newspaper of the Coast and reaching more than ten thousand service stations, garages, car dealers, oil company employees, and distributors, etc. With full credit, of course.

Wayne Goble

Automotive Dealer News
Los Angeles, California

To The Petroleum Engineer:

I have received a reprint of the article "What's Wrong With Being an Oil Company?" by Ernestine Adams, which recently appeared in The Petroleum Engineer.

As you know, we publish the monthly magazine, *South Texan*, which has a wide distribution in the South Texas region. We would like very much to have your permission to reprint this article, of course giving full credit to Miss Adams and The Petroleum Engineer.

Ray Leeman

Executive vice president
South Texas Chamber of Commerce
San Antonio, Texas

To The Petroleum Engineer:

I noted your excellent article "What's Wrong With Being an Oil Company?" in *The Petroleum Engineer* with a great deal of interest. I can well imagine that you will receive numerous requests for permission to reprint in company employee magazines, etc., and will you allow us this permission in a forthcoming issue of The Sunray News?

Luther Williams

Sunray Oil Corporation
Tulsa, Oklahoma

To The Petroleum Engineer:

"What's Wrong With Being an Oil Company?" is a great piece of writing.

Jake L. Hamon

Dallas, Texas

To The Petroleum Engineer:

Enclosed is a memorandum with which I transmitted your recent article to our Plymouth stockholders . . . Your article has been received most favorably, and I am delighted with the comments it aroused.

We also published it in *The Pioneer*, our house organ.

W. S. Hallanan

President
Plymouth Oil Company
Pittsburgh, Pennsylvania

To The Petroleum Engineer:

I was very much interested in reading the editorial, "What's Wrong With Being an Oil Company?". It is an excellent presentation of this very important subject.

R. G. Follis

Chairman of the Board
Standard Oil Company of California
San Francisco, California

To The Petroleum Engineer:

I have read with much interest your comments entitled "What's Wrong With Being an Oil Company?". Your remarks are so much to the point that if available, I would like to distribute some copies to friends.

Allow me to congratulate you on bringing to public notice the over-all responsibility of maintaining the oil industry of the United States.

J. W. Cappeau

Kay, Richards and Company
Pittsburgh, Pennsylvania

To The Petroleum Engineer:

We have received a reprint of "What's Wrong With Being an Oil Company?" by Ernestine Adams which we note is copyrighted. May we have permisison to reprint this article in our *Missouri Oil Jobber?*

Robert W. Hadlick

Executive Secretary
Missouri Petroleum Association
Jefferson City, Missouri

To The Petroleum Engineer:

I read with a great deal of interest your article, "What's Wrong With Being an Oil Company?" This is the type of public relations information that the oil industry certainly needs and I think your article will meet the approval of every oil executive in the country.

The only criticism that I have of your article is that you fail to mention asphalt as one of the outstanding oil products. Considerably more than fifty per cent of our improved roads and airports are constructed with asphalt and were it not for the economical use of this petroleum product, we could not possibly have met the road problem as well as we have, except at a prohibitive cost.

Asphalt roads are becoming of greater importance every year, not only to the petroleum industry but to the public in general, as they are capable of withstanding greater wheel loads than portland cement concrete and the public is rapidly accepting them as a better and more satisfactory road for automobile traffic.

In addition to the use of asphalt for highway and airport construction it is also used in a vast number of industrial projects so that it is a very important petroleum product which, in my opinion, has received entirely too little credit for the results that have obtained from its use.

Again congratulating you on your excellent article.

H. B. Pullar

President
Berry Asphalt Company
Chicago, Illinois

To The Petroleum Engineer:

I have just read with great interest your article, "What's Wrong With Being an Oil Company?". I assure you this is one of the finest articles that I have read in a long time and I want to congratulate you on the way you have handled the matter.

I assure you I represent no oil company, but I am interested in the industry as a whole and I believe that this article will do a great deal of good in correcting a wrong impression.

Earl Foster

Interstate Oil Compact Commission
Oklahoma City, Oklahoma

To The Petroleum Engineer:

We wish to congratulate you on your fine article, "What's Wrong With Being an Oil Company?", which appeared in the April, 1951 issue of *The Petroleum Engineer*. To our mind, you told the story the way it should be told, with pride in what the industry has accomplished, rather than apology.

May we have permission to reprint your article in three of our publications?

Wilfred B. Talman

The Texas Company
New York, New York

To The Petroleum Engineer:

Thanks for your article "What's Wrong With Being an Oil Company?" which I have just finished reading in the April issue. This article should be published on the front page of every newspaper in the United States.

Mrs. S. J. Knepley

Lewie Montgomery Trucking Company
Odessa, Texas

To The Petroleum Engineer:

Dr. Wilson liked your story, "What's Wrong With Being an Oil Company?". And so do I. Could you send me a half dozen copies?

Conger Reynolds

Standard Oil Company (Indiana)
Chicago, Illinois

To The Petroleum Engineer:

"What's Wrong With Being an Oil Company?" gives interesting facts, is well written, and is most timely. Certainly the presentation of such facts is needed to combat the propaganda we have been hearing about oil companies and men in the oil business.

Ernest O. Thompson

Railroad Commission of Texas
Austin, Texas

To The Petroleum Engineer:

I have read with considerable interest "What's Wrong With Being an Oil Company?". You are to be complimented on a very good article.

Harold Decker

President
Houston Oil Company of Texas
Houston, Texas

To The Petroleum Engineer:

I just had the opportunity last night to read your article, "What's Wrong With Being an Oil Company?" It is really wonderful and I congratulate you on it.

If the oil business—and the gas business — just had a dozen people who could express these ideas in the simple words and down-to-earth terms that you use in your article, we would have a great deal less trouble making the general public understand that our industry, privately managed, is today operating and will always operate much more in the public's interest than any bureaucratic system of government control.

Jack Clarke

Texas Eastern Transmission Corporation
Shreveport, Louisiana

CORROSION NOW POSES A DOUBLE THREAT

Worn out and corroded equipment may not be replaceable

Don't take chances on vital equipment. Scarce metals and materials are becoming scarcer. Farsighted business men are rebuilding, repairing and *protecting* to insure continuity of their operations.

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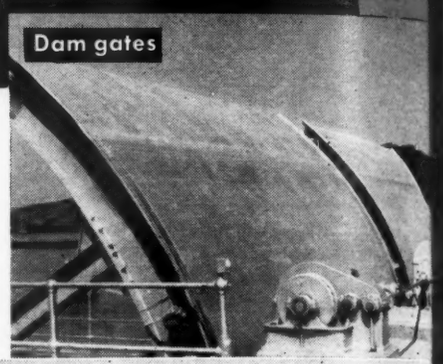
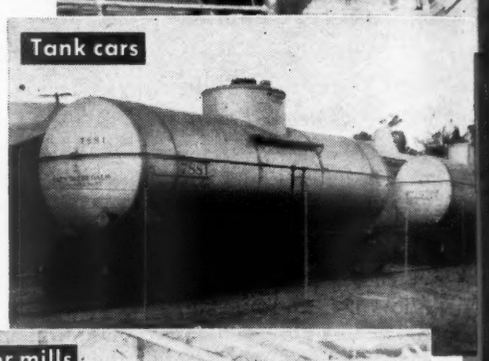
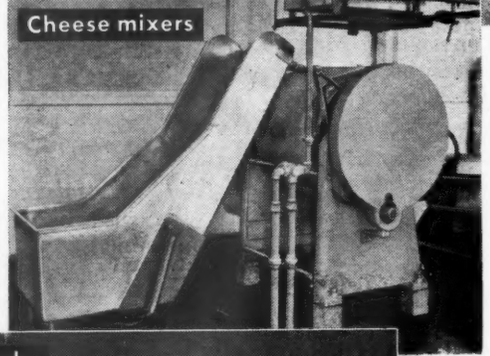
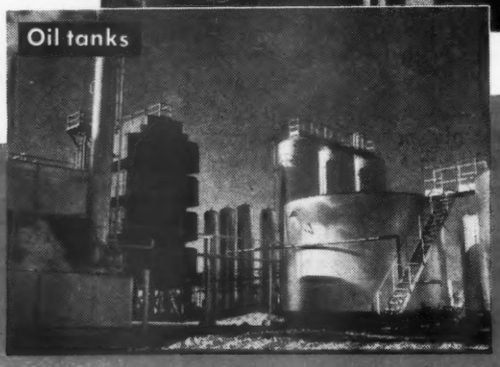


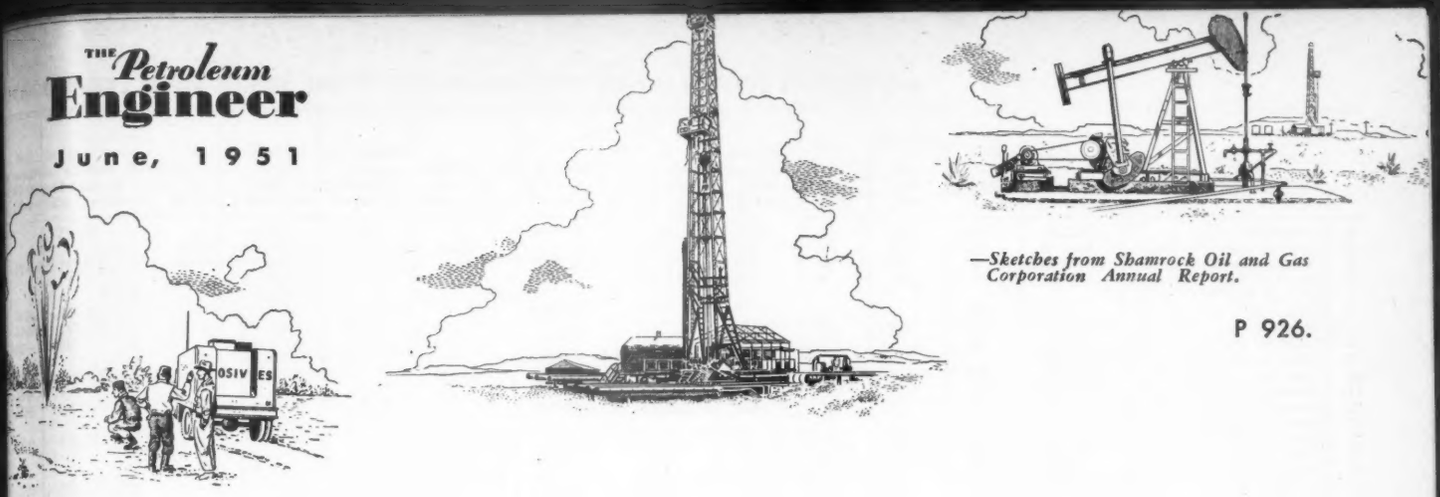






FOLLOW THE LINE OF *most* RESISTANCE

THE Petroleum Engineer
June, 1951



—Sketches from Shamrock Oil and Gas Corporation Annual Report.

P 926.

Industry Smoothly Meets Record Demand

Production and refinery runs each gain a million barrels a day in 1950 — Research gives a star performance, annual reports show

ERNESTINE ADAMS*

THE eager beaver oil industry outdid itself in 1950 and seems to be throwing that record out in 1951. The annual reports of the oil companies for 1950 and the first quarterly reports for 1951 show an almost incredible gain in drilling production, refinery runs, demand, reserves, gross profits, and taxes.

The 1951 first quarter gross income for the industry ran about 30 per cent over that for the first quarter of the year before for the same period. Heavier expenses and taxes would probably cut the net profit to a much lower figure but sales were booming.

States the Plymouth Oil Company report: "The industry drilled more wells, increased reserves to an all-time high, refined more oil and produced more motor fuel, natural gas and natural gas liquids than ever before, as it met a demand for its products that reached a record high for the eighth consecutive year."

Shell Oil Company's report recalls the fact that oil probably supplied 5 per cent of the energy for the U. S. in 1900 while in 1950 oil supplied 40 per cent and gas 17 per cent; both providing well over half the energy consumed.

The rapidly rising consumption was explained by Gulf Oil Corporation, which reported 9 per cent increase in motor vehicles in 1950 over 1949, 8 per cent increase in tractors, 12 per cent in diesel locomotives, and 14 per cent increase in home burners.

"By late summer 1950," Ohio Oil Company's report pointed out, "the rate of production had surpassed the previous peak attained in December 1948. These high levels of operation in production and refining were matched in the transportation and distribution branches of the industry without undue difficulty—a tribute to the industry's well balanced expanded capacity in which billions of dollars were invested during the past five years."

Continental Oil Company attributed the oil industry's ability to provide large increases to the vigor and growth generated within it by keen competition and economic incentives.

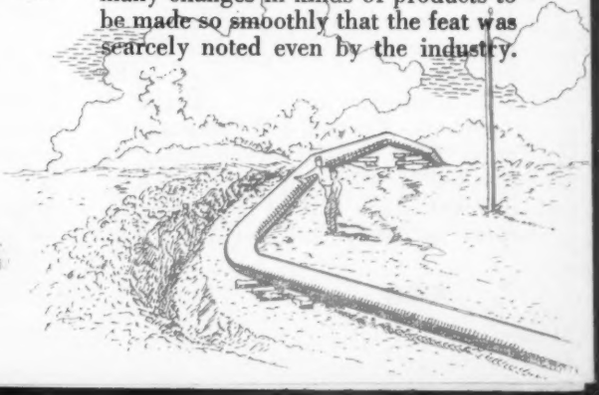
Although Humble Oil and Refining Company speaks only of its own company when it comments on the "high morale which has characterized the history of the company" and "the loyalty and effective work of employees and the confidence shown by stockholders," the phrases fit the whole indstry.

Rising consumption and the Korean war touched off the dynamo. The wheels began to turn faster and faster. Drilling went to an all-time high after a slow start. Production and refinery runs each gained a *million barrels a day* in the year. Despite the large and sudden military demand and the steadily increasing civilian consumption, there were no shortages; every demand was supplied. The industry rushed to meet every need. Closed down fields were reopened, synthetic rubber plants were activated, research departments turned to processes for aromatics, lubes for low temperatures, and other special military needs.

Nobody ever saw anything like it. Never before had the industry expanded so much so quickly. Never before could it have done so. The billions spent since World War II to enlarge the industry's capacity was paying off. The industry's extraordinary flexibility permitted both the tremendous range in quantity and the many changes in kinds of products to be made so smoothly that the feat was scarcely noted even by the industry.

*Managing Editor.

EXCLUSIVE



	Company	Acreage lease and fee dev & undev	Wells drilled 1950, net	Oil & gas prod. wells drilled, 1950	Dry holes	Net prod. oil & gas wells owned	Daily avg. crude prod, net bbl	Daily avg. refinery runs barrels	Natural gas produced million cu ft	Estimated crude oil reserves[20] million bbl	Gross income 1950 thousand $	Compared to 1949 %	Gross income 1st quar 51 thousand $	Comp'ed to 1950 %
1	Amerada Pet. Corp.	6,407,000	211	136	76	2077	52,387	none		500	58,904		16,776	
2	American Republics Corp.	989,720	130	105	25	250	8,630	none	10,357		17,495	+49		
3	Anderson-Prichard	214,000	67	45	22	672	8,129	17,348		40	30,767	+15	7,731	+24
4	Argo Oil Corp.	240,656	40	31	9	455	6,700				7,371	+ .2		
5	Arkansas Fuel Oil Co.										122,208			
6	Ashland Oil & Ref.		233				7,800	83,000			142,452	+42	49,766	+46
7	Atlantic Refining Co.†	3,517,000	326	258	68	3,167	82,974	158,761		507[17]	477,982	+ 7	141,742	+25
8	Bishop Oil Co.	26,025	12	9	3	296	2,452		465		1,425	— .2	446	+39
9	British American Oil Co.†	3,400,000[26]					16,000[27]	50,500		65‡	135,305	+16		
10	Cities Service Company	7,100,000	506	441	65		112,432	210,550	210	[8]	702,242	+19	221,242	+33
11	Continental Oil Co.[9]	5,300,000	442	334	108		104,427	95,669	107,000	550	348,035	+ 9	93,014	+24
12	Creole Petroleum Corp.[16]		149	138	11	2,422	555,910	113,164		4,150	515,615	+19	48,000	+37
13	Crown Central Pet. Corp.										40,150			
14	Deep Rock Oil Corp.	404,731	132	105	27	2,108[23]	8,095	13,452	703		37,745	+ 2	12,111	+26
15	Derby Oil Co.	95,326	77	32	45	433	3,007	8,853			15,514	+ 6		
16	Douglas Oil Co. (Calif.)	31,593					1,947	1,753			16,296	—18		
17	Gulf Oil Corp.†	77,700,000	1,032	853	179	15,449	530,000	448,000	167,000	3,100	1,150,094	—19	31,972	+23
18	Hancock Oil Co.[2]		17			199	12,700	10,636			47,279	— 7	14,116	+16
19	Houston Oil Co.	1,253,000	72	52	20		11,244		29,000		20,592	+11	6,409	+34
20	Honolulu Oil Corp.	1,548,851	51	34	17	1,723[22]	26,204	none	12,734	165	22,146		6,024	+15
21	Humble Oil & Ref.[14]	15,879,098	816	669	147	10,294	303,200	222,000	169,441	2,900	793,417	+ 4	[25]	
22	Imperial Oil, Ltd.[15]	21,000,000	464	406	58	861	36,100[28]	170,500	2,400	665	432,485	+12		
23	Lion Oil Co.	1,336,449	107	93	14	680	18,928	21,251	8,162	165	81,960	+25	22,354	+11
24	Louisiana Land & Exp. Co.	802,567	12	9	3		13,197			70	15,579	+18	4,217	+21
25	Middle States Pet. Corp.	1,817,057	89	70	19		9,250	none	14,220	34[13]	9,830		2,511	+ .4
26	Mid-Continent Pet. Corp.	1,420,625	162	113	39	2,036	18,059	48,887	71,980	175	136,697	+10	4,398	+58
27	Ohio Oil Co.	2,515,855	250	198	52	7,383	82,856	35,710		600	196,668	+17	49,990	+14
28	Pacific Western Oil Co.	414,387	13	9	4	521	8,829	none			7,317	—10		
29	Pan American Pet. & Trans.[3]	487,986	113	105	8	568	18,903	116,024	12,196		322,892	+18	95,752	+35
30	Panhandle Prod. & Ref. Co.		23	20	3		3,921	4,854	6,623	9	10,937	0	3,141	+22
31	Phillips Pet. Co.	8,759,452	480	430	50	10,932	100,523	182,500	630,000	950[31]	534,063	+11	15,900[30]	+58
32	Plymouth Oil Co.	576,082	48	41	7	582	16,831	32,800	32,042	250	73,298	+75	24,426	+52
33	Pure Oil Co.	2,781,880	195	178	17	6,190	69,410	117,784	26,414	500	299,880	+14	77,213	+34
34	Quaker State Oil Ref.						2,334	8,484			47,464	+ 9		
35	Richfield Oil Corp.	211,800	155	140	15	994	62,975	96,961		408†[17]	154,945	+26	44,085	+37
36	Seaboard Oil Co.		138	100	38		28,043	none	22,000	180	28,158	+11	8,253	+12
37	Shamrock Oil & Gas Corp.	460,000	27	22	5	94	1,730	7,863	231		27,918	+13		
38	Shell Oil Co.[9]	8,978,666	393	341	52		198,000	343,000	156,116	900	911,484	+12	260,172	+22
39	Signal Oil & Gas Co.	799,000	77			616	40,841	none	7,370		23,295			
40	Sinclair Oil Corp.	6,954,575[4]	378	332	47	7,130	96,612	307,547		707[17]	678,877	+16	202,168	+30
41	Skelly Oil Co.	3,247,130	295	239	56	3,363	54,949	39,892	88,918	230	174,345	+ 7	47,343	+24
42	Socony-Vacuum Oil Co.†		830			12,260	345,000	538,000	267,000	3,821	1,405,155	+12		
43	South Penn Oil Co.	737,196[21]	201[22]	110	1	12,247	11,829	8,035	10,686	49‡[11]	54,819	+15	14,200	+20
44	Standard Oil of Calif †	5,975,708		421		6,498	310,632	302,623	162,221	1,500	869,450	+12	239,749	+33
45	Standard Oil of Indiana	12,129,555	725	632	93	9,669	199,463	462,073	208,092	1,300	1,318,183	+13	33,749	+37
46	Standard Oil of N. J.						1,212,000	1,600,000		6,800[24]	3,198,266			
47	Sun Oil Co.	6,100,000	485	375	110		94,794	173,787	73,000	733	495,529	+ 7		
48	Sunray Oil Corp.	3,159,747	176	146	30	3,237	51,594	35,691	32,607	400	90,626	+55	31,031	+119
49	Superior Oil Co.		200	157	43		53,600		41,000		53,501	— .2	15,283[5]	+23
50	The Texas Company†	97,147,245	969				281,930	384,453		4,991‡	1,309,283	+17	314,602	+23
51	Texas Gulf Prod. Co.	178,870	28	19	9		9,247	none	9,251	50	9,811	+ 6	2,657	+17
52	Texas Pacific Coal & Oil	1,079,017	89	61	28		15,525	none		85	15,262	+14	4,247	+29
53	Tide Water Associated[7]	1,736,409	176	157	19	5,431	89,287	160,234		517‡	356,984	+ .04	102,217	+21
54	Union Oil Co. of Calif.†		137	100	37	2,958	74,372	119,071		459‡	217,159	+ 6	68,058	+31
55	Universal Consol. Oil Co.	23,500	14	7	7	249	5,980	none			5,459	+ 2	1,756	+25
56	Warren Pet. Corp.[19]	416,026	73	53	20		5,024	none	13,206		63,635	—30	64,643	+35[29]
57	Wilcox Oil Co.	72,500	20	8	12	316	2,201	4,386	3,432		9,2?4		2,718	+15

[1] $168 million of this paid to Venezuela.
[2] No income from Tidelands properties.
[3] Affiliate of Standard of Indiana.
[4] Domestic only.
[5] This is one-half of 6 months report to March 1, 1951.
[6] This includes Barnsdall purchase after June 28, 1950.
[7] Majority stock owned by Mission Development Company and Pacific Western Oil Corporation.
[8] This is 14.1 trillion cubic feet of gas reserves controlled.
[9] U. S. and Canada only.
[10] Also 7000 billion cubic feet of gas.
[11] Also 99 billion cubic feet of gas.
[12] Domestic.
[13] Also 142 billion cubic feet of gas.
[14] Standard of N. J. owns 72%.
[15] Standard of N. J. owns 70%.
[16] Standard of N. J. owns 94%.
[17] Estimate by DeGolyer & MacNaughton.
[18] Payroll only.
[19] For year ending June 30, 1950.
[20] For nine months ending March 31, 1950.
[21] Includes 60,799 acres royalty only.
[22] Includes 90 water intake pressure wells.
[23] Wholly owned and joint venture wells.
[24] Includes affiliates.
[25] First 4 months of oil production up 39%; refinery runs up 30%.
[26] Canada only.
[27] U. S. only.
[28] Gross production.
[29] Unless otherwise indicated estimates are by investment advisory services.
[30] Net.
[31] Also 15 trillion cubic feet of gas.
† Domestic and foreign.
* Also dividends in stock splits or extras.
‡ Estimates by company.
§ Also dividend in re-acquired stock valued at $1.02 per share.

New Wave of Expansion

When World War II was over the petroleum industry laid out a program of expansion that was to replace its worn out equipment and enlarge its capacity to take care of a larger consumption. Most of that program has been carried out and just as it nears completion a new surge of demand calls for even greater expansion to maintain the ability to meet sudden changes with confidence.

In 1950 capital expenditures went over the $2 billion mark. If plans for 1951 are fulfilled, capital additions will amount to something like $3 billion, including foreign operations by U. S. companies and their affiliates.

Socony-Vacuum Oil Company reports "Our capital expenditures as planned for 1951 approximate $200,000,000, about a third more than we spent in 1950. Some of these projected expenditures may have to be curtailed or delayed because of shortage of critical materials. On the other hand, we, in common with other oil companies, may have to expand our plants and equipment more than presently anticipated to produce larger quantities of specialized petroleum products needed by the military."

The twin spurs to expansion of capacity are the desire of all producing companies to add to their reserves and the government provision partly to charge off processing plants that provide military supplies.

As The Derby Oil Company describes it: "The company has been granted a Certificate of Necessity which provides for an acceleration of depreciation on 75 per cent of the cost of its refinery expansion program. The privilege of charging off 75 per cent of these improvements over a period of 5 years will be a further cushion against excess profits taxes and will return invested capital at a much earlier date than under normal depreciation procedure."

Already more than a half billion dollars in new refining facilities are covered by these certificates of accelerated amortization.

Material Shortages

One deterrent to this new wave of capital additions is possible shortages of materials. The Standard Oil Company (Indiana) report states, "Our budgets indicate a substantial increase (of capital expenditures) but shortages of materials and building restrictions may tend to reduce this."

The Humble report commented that the company had planned to complete 90 wells more than it did in 1950. Plans could not be carried out be-

FINANCIAL STATISTICS FOR 1950-51 AS FOUND IN THEIR ANNUAL REPORTS

	Net 1950 income after taxes thousand $	Direct taxes federal, state, & local[19] thousand $	Taxes, per cent of net income	Common stocks, thousands of shares	Net income per common share, $	Taxes per common share $	Cash dividends per common share $	Gasoline & oil taxes, Federal & state, thousand $	Average number of employees	Total payroll & employee benefits, thousand $	Net capital assets thousand $	Capital expenditures, 1950 thousand $	Capital expend. 1951 estimated thousand $	Current assets, thousand $	Current liabilities, thousand $	Ratio current assets to current liabilities
				1,844			6.00*				43,941			32,387	8,324	3.9
	4,849	1,151	24	1,500	3.23	.77	1.00		690			4,916		14,108	2,946	4.8
	4,685	1,577	34	813	5.76	1.93	1.55		500		22,597	5,498		9,215	4,226	2.2
	2,868	917	32	1,670	1.72	.55	.75				14,132		5,000	5,028	1,600	3.1
	8,396	6,590	78	102							39,296			28,446	13,245	2.1
	10,004	6,821	68	1,656	5.21	4.12	1.60				42,583		20,000	55,552	20,643	2.7
	40,842	24,973†	61	2,987	13.09	8.36	2.75	50,175	19,273	76,432[18]	278,357	38,769	50,000	138,459	62,479	2.2
	276	104	38	345	.80	.31	.20				2,501	849	700	950	647	1.5
	10,489	14,059	134	3,717	2 81	3.79	1.00	27,000	4,000	14,592	78,468	21,368		52,059	27,927	1.8
	56.659	47,138	83	3,889	14.57	11.55	5.00*			77.936	590,717	66,000		314,316	131,418	2.4
	42,406	23,447	55	4,858	8.73	4.82	5.00		8,014	33,300	156,478	43,725	61,000	112,957	43,789	2.6
	166,9°0	238,576†	142	25,865	6.45	9.22	3.40		14,500	96,245	473.899	43,334		235.419	128,194	1.8
	1,571	984	63	825	1 90	1.19					7,034			9,945	5.947	1.7
	2,980	935	31	399	7.46	2.34	2.00	3,716	1,190	5,145	21,984	5,378		11,278	4,590	2.5
	1,093	605	55	402	2.71	1.50	1.00		350	13,110	7,049	1,326		11,733	9,169	1.8
	87	131	150	935	.08	.14	0				2,421	296		2,528	1.530	1.6
	111,140	91,614	82	11,345	9.80	8.07	4.00	173,072	43,400	172,000	704.723	129,350	200,000	461.286	204,659	2.2
	3,218	1,349	42	277	11.58		4 00	6,674			1.776	423		18.775	4,012	4.7
	5,905	3,436	58	1,098	5.37	3.13	2 50		700	28,759	41,579	7,093		10,686	4,458	2.4
	6,723	4,019	60	1,875	3.58	2.14	2.50*		437		28,541	3,000		17,450	3,816	4.6
	129,359	60,500	47	17,975	7.20	5.78	4 00	43,500	17,653	100,305	679,566	110,490		251,096	98,142	2.6
	30,460	33,020	108	27,133	1.12	1.22	.55		12,500		396,014	45,475		206.355	43,439	4.8
	13,988	8,415	60	2,341	5.98	3.60	1.87½	7,616	2,363	10,141	50,972	13,685		26,639	11,984	2.2
	9.075	5,288	58	3,000	3.05	1.76	2.50		35		5,601	2,180		10,902	4,569	2.4
	3,704	762	20	1,980	1.87	.38	1.25*				27,239	5,935		4,487	4,507	.9
	15.662	17,083	109	1,879	8.43	9.20	3 25	17,214	3,200	12,857	76,822	19,137		72,233	20,164	3.6
	37,349	18,730	50	6.563	5.69	2.85	2.70	11,192	5,980	28,282	212.006	31,481		86.478	28,995	3.0
	5,863	400		1,374	4.27		Stk.				19,607			6,822	2,767	2.5
	20,325	18,390	90	4,702	4.30	3.98	1.50*	50,705	7,786	32,478	121.922	24,721		95,393	48,660	1.9
	1.296	472	36	1,448	.90	.33	.20		200	1,500	12,434	919	800	3,908	2,655	1.5
	51,557	37,086	74	6,084	8.51	6.24	3 50	80,000	18,381	84,728	667,231	92,644		176,878	83,198	2.1
	8.498	3.775	44	1,213	7.01	3.11	2.00*§		1,076	5,428	39,584	7,787		22,103	12,706	1.7
	30.329	18.316	60	3,982	7.06	4.60	2 00		10,000		207,241	35,000		93,227	25.973	3.6
	3,084	2,980	97	4,273	3.33	3.21	2.00*	4.993	1,902	5,974	12,832	2.465		5,206	4,426	1.2
	23,046	15,081	65	4,001	5.76	3.77	3 00*	24,417	4,376	20,823	108,406	28,529		84.559	25,022	3.4
	6,107			1,231	4.99		2.60				17,892			13,429	4,002	3.4
	4,764	2.235	47	1.345	3.54	1.66	1.60			58,945	25,062	6,819		7,112	5,078	1.4
	90,121	77,265	86	13,470	6.69	5.74	3.00	134,047	30,305	156,466	343,382	86,651	120,000	330,381	142,211	2.3
	7,502		24	1,027	7.30	.76	1.50		539	3,112	14,806			10,141	4,165	2.4
	70.193	45.084	64	12,078	5.81	3.73	2.50	117.0o0	20,891	89,724	469,916	95,012		302,335	126,583	2.4
	28,514	10.595	37	2.611	10.91	4.06	2 75	15,620	4,419	17,273	155,934	34,703		53,196	25,540	2.1
	128,210	78,925	62	31,811	4.03	2.48	2 35*		42,800[13]	199,000	819,633	145,447	200,000	513,807	199,288	2.6
	7,607	6,558	86	1,733	4.39	3.79	7.37	4,820	2.535	9.552	21,088	3,989	6,000	28,993	10,029	2.9
	150,804	100,126	66	28,673	5.26	3 49	2 50		30,671	131,764	852,476	183,000		334,429	144,504	2.3
	123,581	88,020	71	15,284	8.09	5.76	3.13½*	183,196	46,739		1,165,717	123,438		478,616	178,858	2.7
	408,223	276,091		30,285			5.00*	294.749	116,000	548,205	2,125.405	295,132		1,542,210	495,079	3.1
	36.291	22.545	62	5,967	6 02	3.78	.91	75,097	18,335	81,667	197,626	31,600		124,999	46,784	2.7
	20.462	9.050	44	5,059	2 97	1.79	1.00		2.229		212.136			57,678	24,150	2.4
	6.928	3,877	56	425	16.38	9.12	3.00		2.229		60,500	29,385		29,124	8,107	3.6
	149,071	77,073	52	13,797	10.82	5 60	6 50	198,406	38,246	163,555	789,034	141,251	200,000	469,429	123,147	3.8
	3.047	1,503	49	1,106	2.75	1.36	1.25				16,713	2,983	4,330	4,210	2,194	1.9
	5 997	2,106	35	1,774	3.38	1.18	1.50		398		25,572	7,530		6,318	1,662	3.8
	33,364	19.067	57	63,968	5.17	.30	1.90	45,656	11,386	48,057	176,299	25,603	35,000	106,327	41,077	2.6
	17,177	12,662	31	5,266	3.26	1.03	2 00*	40,333	7,826	36,405	243,669	32,721		90,867	33,231	2.7
	2,278	942	41	278	8.18	3.39	2.00		115	603	1,994	203	118	5,050	595	8.5
	4,476	3,010	67	1,702	1.63	1.76	.80		1,315	5,637	16,565	6,511		14,412	8,571	1.7
	704	320	1.14	281	2.50	1.14	.70*	1,038	210		4,149	1,031		2,297	1,164	2.0

cause of insufficient materials. Texas Gulf Producing Company reports that it has only been able to get one-half its pipe requirements through regular channels in recent months and has to pay premium prices for other pipe.

Phillips Petroleum Company's annual report warns the industry must have tools for its work: "The oil industry made numerous changes in its operations to supply the increased military needs for specialized products. These necessary adjustments were accomplished so promptly that the military was never hampered by product shortages.

"If the industry is to achieve the essential goals of producing, manufacturing, and transporting petroleum products in the quantities needed, it must have the necessary tools. Few industries depend so heavily on steel, and substitutes seldom suffice. Currently the industry is suffering from a shortage of steel, and its operations cannot be accelerated until adequate supplies are made available."

Dealing with shortages, the Plymouth report says: "The overall mobilization program has already produced shortages of critical materials necessary to an expanded program of discovery and development, which both civil and military agencies of the government regard as essential to the national safety. The Petroleum Administration for Defense is endeavoring to alleviate these production bottle necks in an equitable manner within the limits of available supply."

Generating Capital

Another hindrance to larger expansion is what Sun Oil Company's report calls generating capital. "The task the petroleum industry faces in generating capital to maintain as well as to expand its productive capacity in the future will be made more difficult by price control, increased taxes, and further inflationary pressure on the value of the dollar."

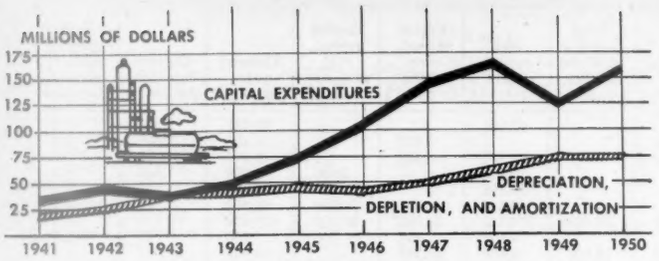
This problem was being met by retaining the bulk of the so-called net profits in the business, and by borrowing or issuing new stock. Depreciation and depletion charge-offs did not come near paying for additions. Shell is one of very few whose capital investment of one-half billion in the last five years has come entirely from write-offs and retained earnings. The great majority of companies borrowed funds or sold stock for more capital.

Houston Oil Company said that its capital expenditures were well over two times the provision for depreciation, depletion, and abandonments.

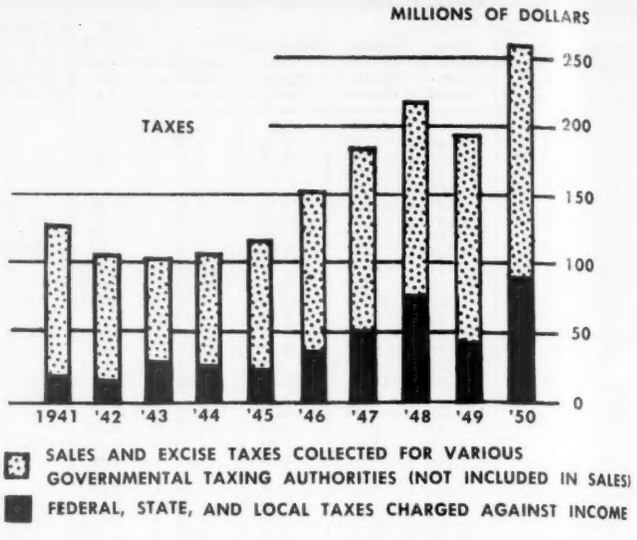
Tide Water Associated Oil Company was one of a few that kept its write-offs and capital expenditures virtually balanced.

In relation to net income, probably half the oil companies paid more for maintenance and expansion in 1950 than they made in "net profit." These large capital outlays are for long term gains, including millions spent on pressure maintenance units. To conserve cash for added construction, stock splits or stock dividends were popular. The stockholder was getting a much higher equity investment and, in addition, he fared comparatively well in cash returns.

The Union Oil Company of California report explains, "A large share of the amount reported as 'net income retained in business' has been required to cover the excess of replacement costs over the amounts recovered through depletion and depreciation allowances." And the report



Standard of California charts the gap between its tax allowance for depreciation and depletion and its actual new investment in property.



Gulf Oil Corporation shows the growth of its tax bill. It paid, in 1950, taxes equivalent to $6099 for each employee or $23.33 for each share of capital stock outstanding.

points out that these have not been "real" earnings although they have been taxed as such.

The matter is put thus by the Pacific Western Oil Corporation report: "The conversion of oil reserves into cash through sales or promotion may appear to create income when in reality it is a return of capital until the property has produced enough oil to repay all development and operating costs."

The tax allowances were hit two ways. They were inadequate to cover needed expansion if the dollar value had remained the same. But the dollar was roughly half the value it was when most of the equipment now being replaced was bought. The Sun Oil report showed where the construction dollar was even less than the consumer dollar, about 42 cents.

The whole tax allowance situation seems antique in the speeded up economy of the present day. Long term investments are too liable to become short term and short term expenditures may be covering obsolete equipment before the write-off gets a good start.

Taxes

Taking the place of an adequate depreciation and depletion tax allowance were the "cheap dollars," as Tax Expert Beardsley Ruml calls them, created by the excess-profits tax. Ruml said the excess-profits tax was not a burden but a subsidy, providing cheap dollars to pay for development.

The oil industry, it would seem, could conscientiously escape most of the excess-profits tax if materials could be found for expansion. Already the oil industry was supplying the greatest tax returns to all divisions of government of any industry in the U. S. New assessments were either made or under discussion in Washington and state capitals.

In 1950 state and federal taxes on gasoline averaged 6.7 cents, according to The Texas Company annual report, yet the government proposes to make the burden still heavier. "No other essential product bears a tax of the proportions of the gasoline tax," the report reads.

Most of the company reports voiced some uneasiness about the danger of overtaxation, although there was awareness that taxes would have to be raised to meet the war situation.

Quaker State Oil Refining Corporation report stated frankly: "It is unreasonable to assume that our economic system can survive under taxation needed to pay for essential military and governmental expenses and, at the same time, provide largesse for a prodigal government to scatter to the four corners of the earth and to the numerous pressure groups operating here at home."

Several pointed out the shortsightedness of a taxation system that smothered incentive and discouraged development. A number of the annual reports give taxes per stockholder but few show taxes per share, which seems a more accurate figure, one that would mean more to the stockholder. He should know that the company paid so much a share for taxes, which is almost always more than the stockholder received per share. Then he must also pay taxes on the dividends he received for each share.

Price

The year 1950 began with depressed prices and they have changed little. The West Coast particularly had difficulties. In its report Douglas Oil Company of California recalls that at the first of the year petroleum products were in abundant supply on the Pacific Coast and heavy fuel oil was in such surplus that it was shipped to the East Coast at a sharp drop in price.

The Warren Petroleum Corporation report indicates the difference between the first half and last half of the 1950 income. The company's fiscal year ended June 30, 1950, and the decrease in sales from the previous year was marked. Virtually all companies had at least a slight increase because sales in the last half in 1950 more than made up for lower income in the first half.

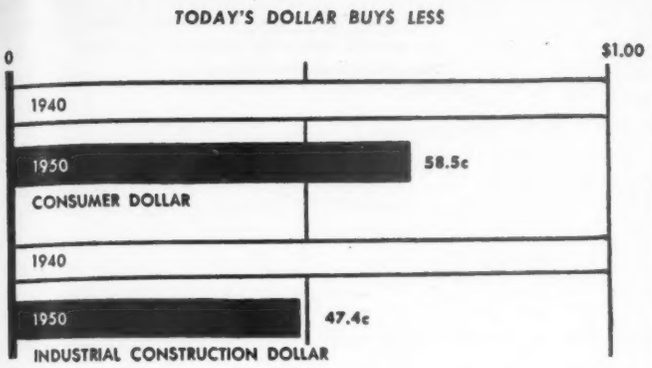
Panhandle Producing and Refining Company reminds its stockholders that the number of shut-in days in Texas were 135 in 1950 compared to 127 in 1949, thus giving it less production in 1950.

Maracaibo Oil Exploration had a smaller operating income in 1950 because of the drop in the price of butane and propane. Natural gas prices, however, increased.

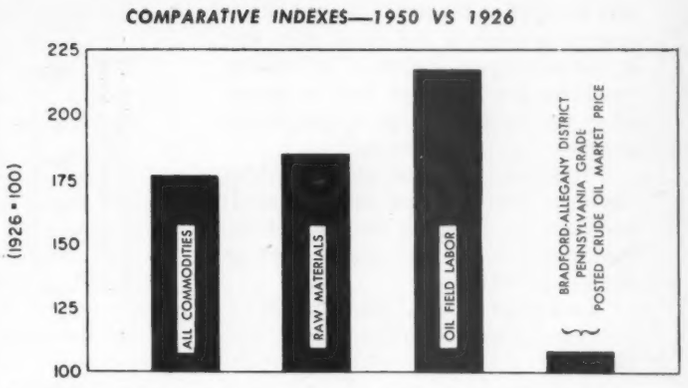
Increase in its gross income, Atlantic Refining explains, was not in any way due to higher prices, which actually averaged somewhat lower than in 1949, but due to increased sales.

Income for some companies were further hampered by the California tidelands decision. Hancock Oil Company, for instance, did not include any income from tidelands properties as this was held in escrow.

"Petroleum prices have not kept pace with the spiral of inflation," Cities Service report read. "Product prices have declined since reaching their peak late in 1948, in spite of



Sun Oil Company compares the effects of inflation in 10 years. The industrial construction dollar gets even less than the consumer for a 1950 dollar.



South Penn Oil Company shows how crude oil prices have remained virtually the same compared to 1926 while other costs have risen sharply.

the fact that taxes, labor, and material costs have continued to soar."

"During 1950 the average domestic service station price of gasoline in 50 representative cities, excluding gasoline taxes, was 4 per cent lower than the 1926 price," reports The Texas Company. Wholesale price for all commodities was 75 per cent above the 1926 level.

Phillips puts in an argument for crude oil freedom from price ceilings:

"The present static crude oil selling price could well become one of the greatest stumbling blocks in our nation's military preparedness program. In the principal producing areas of the United States, the price received for crude oil has remained the same with minor exceptions, for more than three years. This has been a long period of constantly rising operating costs. Every increase in costs has diminished the incentive and ability to find, develop, and produce new crude oil reserves."

And Standard of Indiana does the same for taking off the limits on oil products prices:

"While we do not oppose reasonable overall limits on oil prices in the emergency, rigid price controls on individual products do create serious economic problems in the oil business. Price flexibility is essential in an industry like ours where frequent shifts in yields between different products are necessary to meet varying seasonal demands. Changes in the supply and demand picture in different areas due to unusual weather or other factors also require price flexibility in order to bring about changes in the distribution pattern. Management by government directive is neither sensitive enough nor fast enough to bring about the automatic adjustments that were afforded by free prices."

Research

Ideas were generating with accelerating speed in the laboratories of the research-minded petroleum industry. "Research of today is insurance for the progress of tomorrow," said the Gulf Oil report.

Research was adding new reserves to known reservoirs; it was making the search for new reserves easier; it was adding new products to the petroleum repertoire; it was making the processing of oil products more efficient.

Many companies improved or added to their research plants in 1950. Humble added buildings at Baytown for refining research and at Friendswood for geological research; Deep Rock and Shell also constructed new laboratories. Sinclair early this year opened the doors of its laboratories at Harvey, Illinois, to independent inventors who need facilities for good ideas for better petroleum products.

Phillips was selected by the Atomic Energy Commission to operate the $18,000,000 Materials Testing Reactor being built in Idaho. Standard of California added to its record of accomplishment in the field of atomic energy research.

Among results of the year's research were these achievements:

Stanolind found a new pumping method, which is ready for a field test. It is said to permit the deepest oil wells to be efficiently and economically pumped. The company also found means to increase its ability to produce vital aromatic hydrocarbons.

Sinclair added 108 new lubricating oil formulas to provide increased manufacturing flexibility and improve quality.

Pan-American developed the first regular commercial production of synthetic benzene from petroleum to satisfy the demand that had outstripped the capacity of the coke industry.

Atlantic has evolved a method of high pressure maintenance in producing fields by injection of extraneous gas that is said to promise a vast increase in recoveries in some reservoirs.

Socony-Vacuum developed an entirely new bead catalyst made of readily available materials for use in a new type catalytic reforming process for improving the anti-knock quality of gasoline. From manufacturing the catalyst came a by-product that was used in making a new drilling mud that seals underground fissures and thus prevents undue mud loss.

Shell worked out methods for reducing or eliminating economic loss from casing corrosion in oil wells. Lion Oil developed a cotton herbicidal oil whose purpose is to kill weeds around cotton plants and thus eliminate hand chopping of cotton.

Union of California continued its research on producing and refining of shale oil. It also developed a special airblown asphalt to prevent seepage in the linings of canals and has invented a new catalytic process for upgrading straight gasoline.

Phillips has found a new furnace carbon black that imparts to rubber a high resistance to abrasion. Compounded with cold rubber it is said to increase wear resistance of tire treads 25 to 35 per cent.

These are only a few marks of the year's progress. If we named the year for the star performance, we would call 1950 the "Research Year."

Greater Efficiency

Research and study and experiment not only have revealed new methods and new products but have made vast improvements in existing techniques

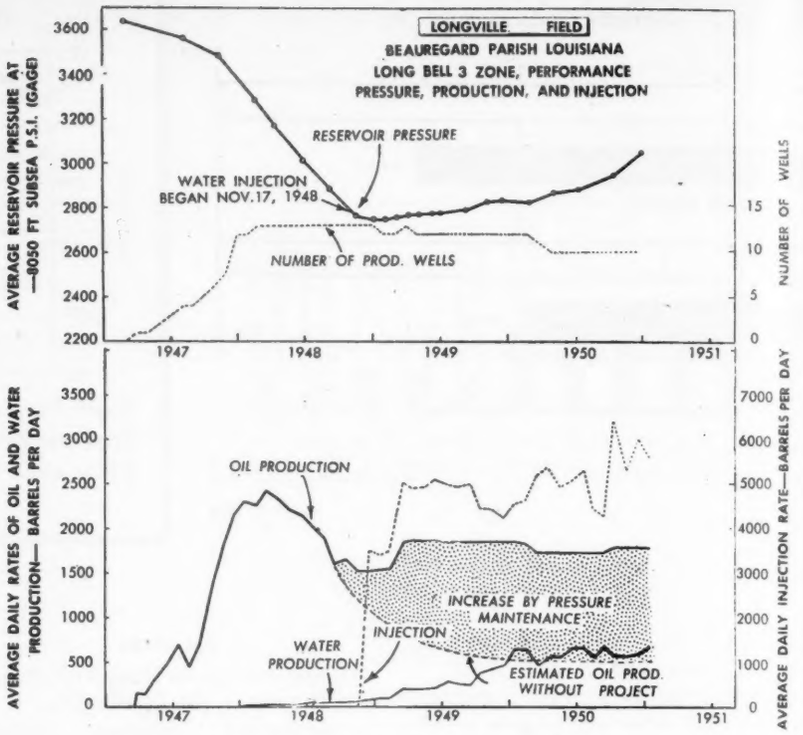
and in administration. The results are money savings to the companies and to the consumer. Prices of petroleum products are not kept low by guess. They are held down by a spectacular capacity for improvement.

Continental pointed to the greater efficiency that reduced average drilling costs by 12.4 per cent a foot despite appreciable increase in average depth per well.

"To a great extent," the Atlantic report read, "ability to hold down unit expense is a reflection of the large investments made for new, efficient plant and equipment over the past few years." Both Atlantic and Union of California mentioned the importance they placed on being in a position to concentrate on the type and quality of petroleum products that produce a satisfactorily profitable return.

Sinclair showed that expenses had decreased 6½ cents a barrel on products sold in spite of increased taxes, increased rates of pay, and increased costs of materials and services.

Humble had reduced operating costs at the well and had reduced direct administrative expense.



Sunray Oil Corporation shows the value of pressure maintenance projects in its annual report.

Reserves

More and more oil companies are including an estimate of their oil and gas reserves in the annual reports. Time was when these were estimated by brokers or accountants but now a substantial number either publish their own estimates or have them made by consultants.

Estimating reserves is a long and difficult job. Socony-Vacuum, for instance, is now engaged in calculating all its natural gas reserves and states that it will take several years to complete the work.

Usually the estimates are conservative. Take the Richfield Oil Corporation estimate, made by DeGolyer and MacNaughton. These do not include the 4 or 5 million barrels in Casmalia field, which are not economically feasible to develop at this time. Nor does it include the 39 million barrels under properties of the City of Long Beach, which are available to Richfield for the life of the properties.

Reserve estimates rarely include the secondary recovery production that has increased potential production sharply. The Texas Company expects the secondary recovery in the Salem, Illinois, field alone to add about 150,000,000 bbl to the company's crude oil reserves.

After paying tribute to the resourcefulness of the industry in finding new reserves, the Seaboard Oil Company report warns: "The fact must nevertheless be faced that much of the 'easy' oil has been found. The search becomes more difficult. Drilling is at greater depths and in less obviously favorable areas. Greater and greater supplies are necessary to satisfy an oil hungry economy."

Results of Pressure Maintenance

	Midway field Arkansas	W. Tepetate field Louisiana	Longville field Louisiana
Gross production rate, 1950			
With pressure maintenance	7,600 B/D	4,540 B/D	1,760 B/D
Without pressure maintenance, est.	3,000 B/D	2,100 B/D	490 B/D
Accumulated gross production to January 1, 1951			
With pressure maintenance	22,051,261 B	10,029,361 B	2,272,114 B
Without pressure maintenance, est.	10,711,016 B	6,947,538 B	1,418,908 B
Estimated ultimate gross recovery			
With pressure maintenance	71,000,000 B	19,900,000 B	4,600,000 B
Without pressure maintenance	28,000,000 B	12,300,000 B	2,200,000 B

From Sunray Annual Report

Conservation Practices

There has been a tremendous advance in producing methods since the last war. Pure Oil calls it "programs which apply modern conservation practices. These vary from pressure maintenance in new fields to secondary recovery practices in the older fields. The latter include injection of gas, water, or air from the surface into the producing horizons in order to provide energy to move to the wells oil which could not be otherwise recovered."

Humble alone spent $50 million from 1945 to 1950 on gas conservation of this type and is working on 6 pressure maintenance projects now that require $5 million and are expected to increase recovery by 17 million barrels.

Mid-Continent Petroleum Corporation has taken a lead in secondary recovery projects, operating 30 wholly owned and having an interest in 3 others. It reports that the North Burbank, Oklahoma, pilot flood project on 160 acres has resulted in increased production from 35 to 900 bbl a day. Shell reported that in the Benton, Illinois, field production has increased from 1500 to 4400 bbl a day and is still rising.

Sunray estimates that developing

pressure maintenance costs only about 15 per cent of the average cost of discovering and developing new fields.

Employees

"A very important asset of a company is not shown on its statement of financial condition," states the report of Anderson-Prichard. "This asset consists of its employees."

It was clear from all annual reports that no oil company over-looked this vital asset. Wages and salaries and benefits had risen. Training programs were expanded throughout the industry. The widening sphere of the industry called for a greater knowledge of techniques and employees were acquiring that knowledge.

There was also a growing significance in the Years-of-Service clubs, which meant that technically trained men and women were more inclined to stay with their jobs and cut the waste of turnover in employment.

In foreign countries, native personnel became a vital question, not only for the company but for the standing of the United States. Creole Petroleum Corporation, in Venezuela, organized a central Human Relations Committee and field committees. These committees are intended to further the company's objectives of better understanding and communication between management and employment and between company and the community in which the company operates.

Foreign Activity

The annual reports recall the fact that the matter of increasing imports was a grave problem at the beginning of 1950. Producing companies found their incomes dropping because output here was cut and imports were edging more and more into domestic markets.

Imports are still a grave problem. Now it is the threat that they might be cut off because of disturbances in the Eastern Hemisphere and domestic consumption has grown to the point where imports are necessary.

Foreign oil operations have always attracted U. S. oil companies but never has the move been so widespread. Canada has drawn scores of American companies to its western oil boom.

The Government of Mexico liberalized its oil regulations to pull U. S. companies back into the search for oil in Mexico.

The group of independent companies that formed American Independent Oil Company carried out exploratory drilling in the Kuwait-Saudi Arabia Neutral Zone. Signal Oil and Gas Company's report stated that three wells had been dry and drilling was beginning on new structures.

The common sense and sane diplomacy of the American oil companies have done much to create good will in the foreign countries in which they operate. Standard Oil of New Jersey indicates that the road is not easy.

"In participating in the development of the world's petroleum resources," reads its report, "the company has encountered over the years many of the problems incident to international trade — currency control, tariffs, extreme nationalism, and even wars and revolutions. Aided by its long experience, however, the company has been more successful than otherwise in meeting these difficulties, as is indicated by its record of growth and achievement. The greater risks sometimes met in overseas operations are often counterbalanced by greater profits when the operations are successful."

One of the accomplishments of U. S. companies under Standard Jersey's leadership was the agreement to provide the United Kingdom with gasoline for payment in sterling, an act that removed gas rationing on the island.

The opening of the Trans-Arabian pipe line was another outstanding achievement of 1950. The tremendous $200,000,000 project was financed and built entirely by private companies operating in the Middle East.

Outlook

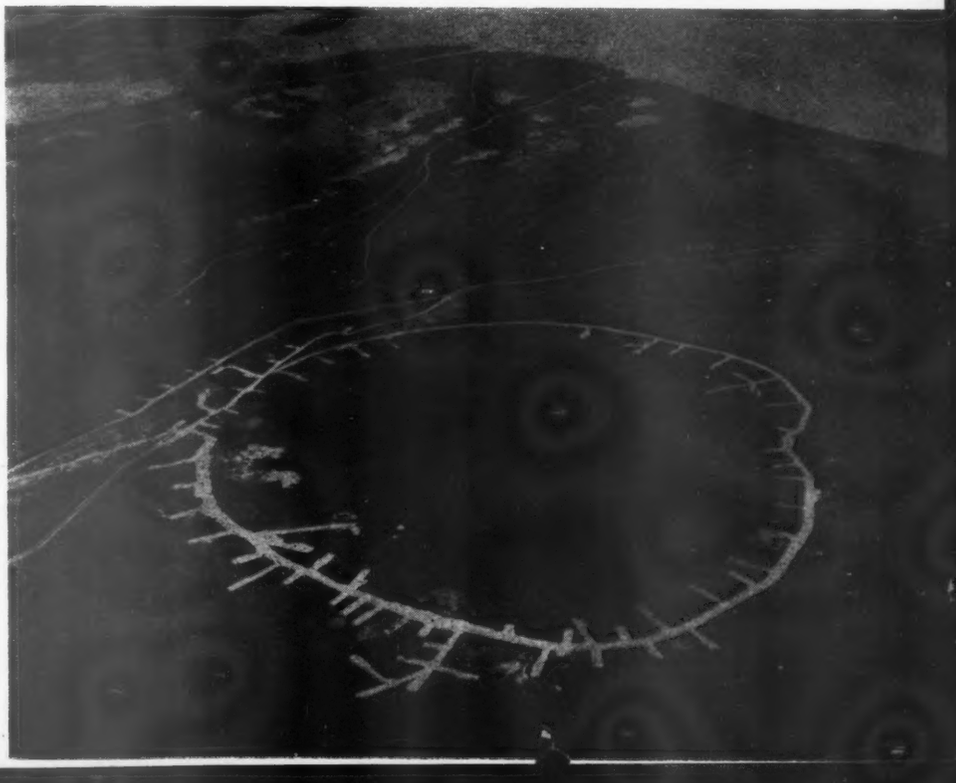
As Quaker State pointed out, "Any comment on outlook is somewhat risky".

High records in output and sales could not hide the fact that there were distinct hazards ahead. Civilian consumption shot up quickly and seemed to be leveling off. Military consumption could be expected to rise further. The ominous situation in Iran caused every company to look to its reserves. Western Europe had to be supplied with oil, if not from Iran, then from the rest of the free world.

Sun Oil Company reminded its stockholders, "There is no profit in war for American industry; it seeks primarily to make its most effective contribution to the national safety. Business copes with higher taxes, shortages of materials and manpower, and the government adds to these essential hardships innumerable regulations and directives."

Although there is no profit in war or in defense preparations for the oil industry, it is nevertheless doing its part. Booming and energetic, it is knocking off records right and left, supplying a giant demand without hesitation.

As the South Penn Oil Company report declares: "American oil men can provide the oil required for peace and war provided they are permitted to operate freely under an incentive competitive system." * * *



Aerial view of the Venice oil field. This prolific field, operated by Tide Water Associated Oil Company, produces oil from wells spaced around its entire seven mile perimeter. Gulf of Mexico coastline visible in upper right. Shown is the canal system with drilling barge slips in which 83 wells have been drilled. In the upper left hand corner may be seen the canal system of the West Bay oil field, six miles south of Venice, in which Tide Water Associated Oil Company has a substantial interest. Both fields are located about eighty miles southeast of New Orleans in the marsh-lands of the Mississippi River Delta, Plaquemines Parish, Louisiana.
—From Tide Water Associated Oil Company annual report.

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Close-up of the Morse HY-VO Drives used for transmitting power for the 1500-H.P. 600-R.P.M. Diesel-electric drawworks. Drives are 2″ pitch, 12″ wide.

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b that "couldn't be done"!

PROVIDES MEANS FOR TRANSMITTING POWER TO DRILL 20,000-FOOT HOLES . . . MAKING POSSIBLE 1500-H. P., 600-R. P. M. PORTABLE DIESEL-ELECTRIC DRAWWORKS

Experienced engineers said it "couldn't be done" with conventional chain drives.

It couldn't be done, but the sensational, new Morse HY-VO Drives took the job in stride . . . an assignment requiring drives which would operate *twice as fast* with *three times the load* considered practical by manufacturers for conventional chain drives. And, the job was done with 2″-pitch, 12″-wide HY-VO Drives, allowing the unit to be *portable!*

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Entirely new design principles are used in the HY-VO Drive. Vibration and destructive linear pulsations are virtually eliminated, allowing the HY-VO Drive to operate at tremendously increased rotative speeds, using drives of much narrower widths. Cost-per-hour can be cut by as much as 50 per cent; service life is much longer.

Due to the shortage of materials and production facilities, orders for HY-VO Drives must carry a priority rating at the present time.

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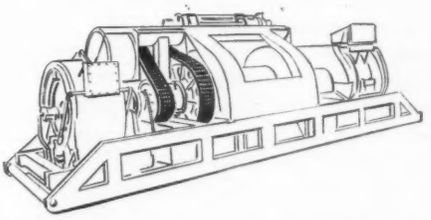
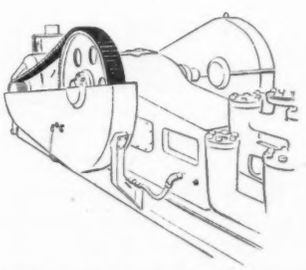


The drawworks, designed and built by EMSCO for Standard Oil Company of California. The rig is the first *portable* unit of its size and power.



The huge mud pumps used in connection with the drawworks are equipped with 1½″-pitch, 8″-wide Morse HY-VO Drives for transmitting 765 H.P. at 1120 R.P.M.

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Petroleum and Natural Gas in Japan†

Oil resources continue to increase in the island country where even slight rise in domestic supply is important

LEO W. STACH*

PETROLEUM and natural gas producing operations in Japan in 1950 continued the sharp uptrend that began in 1949. The results have confirmed the opinion expressed by natural resources section personnel, after thorough study of the situation during 1946, that Japan's petroleum resources were by no means exhausted and that the revival of the industry was dependent on the finding of new reserves awaiting discovery. Additional impetus has been given the industry as a result of a survey of prospects for secondary recovery from the many fields in Japan that are near depletion. The substantial increase in proved reserves during 1950 has brought close to realization the possibility of surpassing, within the next year or two, the prewar peak production of 1937-38. Although Japan's domestic crude oil supplies only 10-15 per cent of the country's requirements of petroleum products, the present and future increases in production will continue to make a significant contribution toward reducing Japan's foreign exchange expenditures on one of its major essential items of imports.

Production

Japan's crude oil production during 1950 averaged 5660 bbl daily, an increase of 51 per cent over the 3748-bbl daily average output of 1949, and 85 per cent over that of 1948. Production of 2,066,060 bbl of crude, including 18,417 bbl of natural gasoline, during 1950 was the highest annual production since 1940 and is 83.6 per cent of the prewar peak production in 1937. During 1950, 97 per cent of the total crude was produced by Imperial Oil Company.

A stable labor situation, increasing efficiency in drilling operations, and sound financial situation resulting from 1949 operations all contributed to the steady increase in production throughout 1950. The daily average increased from 5001 barrels in January to 6088 barrels during the last 3 months of 1950.

The production of crude oil from most of Japan's fields in 1950 did not vary more than 10 per cent from that of 1949; rehabilitation resulted in small increases in several fields without the drilling of new wells. Narahashi field, Yamagata Prefecture, discovered in August 1947, was completely drilled up in 1950 and produced 71,904 bbl in 1950, as compared with 44,175 bbl in 1949. Nishiyama field, Niigata Prefecture, as a result of the drilling of the new extension in the Betsuyama area at the north end of the field, produced 79,341 bbl in 1950, an increase of 32 per cent over that of 1949. The largest increase, however, was registered in Yabase field, Akita Prefecture, where production of 1,052,553 bbl during 1950 is 129 per cent greater than that of 1949 and is 51.2 per cent of the total production for Japan. As a result of the exploitation program in the new deep reservoirs, monthly production in Yabase field reached an all-time peak of 109,433 bbl in October 1950, the previous peak having been 100,778 bbl in January 1937.

Total production of natural gas during 1950 was 2,438,974,000 cu ft, somewhat higher than that for 1949; average daily production of 7,385,000 cu ft of natural gas in December 1950 is about 11 per cent greater than that in December 1949. Of the total production of natural gas in 1950, 1,614,494,000 cu ft, representing 66 per cent of the total, was produced from Japan's methane gas fields, where methane is produced with saline artesian water; most of the increase in production was effected in the larger methane gas fields, Niigata, Niigata Prefecture, and Mobara, Chiba Prefecture.

Production from New Wells

During the year Imperial Oil, the major producing company, completed 34 oil producers out of 60 wells drilled and 8 gas producers out of 9 wells drilled, for a total footage of 209,184 ft; total initial daily production from the successful oil wells was 3570 bbl, and from the gas wells 460,000 cu ft. Other companies completed 17 oil producers with a total initial daily production of 53 bbl from 25 wells drilled, for a total footage of 24,307 ft; 70 out of 72 wells drilled for methane gas, for a total footage of 83,624 ft, were successful, and a total initial daily production of 2,120,000 cu ft resulted. Total initial daily production from the 51 new oil producers completed in 1950 for a footage of 233,491 ft was 3623 bbl, as compared with 1538 bbl from 34 producers in 1949 with a total footage of 149,066 ft.

An analysis of the results of drilling (see table) shows that the percentage success rate for exploration drilling (outposts, 58 per cent; new pool tests, 66 per cent; new field wildcats, 0 per cent) compares favorably with that, for example, of California (53, 30, 5 per cent respectively) and maintains the high standards achieved during the past few years as a result of the careful consideration and screening of exploration drilling projects by the Petroleum Resources Development Promotion Council, established as an advisory body to the Mining Bureau Ministry of International Trade and Industry, on the recommendation of Natural Resources Section.

Most of the new production of crude oil was from exploitation of the recently discovered deep reservoirs in Yabase field, Akita Prefecture, exploitation of Narahashi field, Yamagata Prefecture, discovered in August 1947, and the Betsuyama extension of Nishiyama field, Niigata Prefecture, discovered early in 1950. New production of methane was mostly from the Niigata methane gas field to satisfy increasing local industrial demand for this fuel, and in Mobara field, Chiba Prefecture, where the intensive drilling campaign conducted by the Otaki Natural Gas Company has brought production to a level sufficient to justify piping methane gas to the nearby Chiba city.

†From General Headquarters, Supreme Commander for the Allied Powers, Natural Resources Section Weekly Summary No. 284, 18-24 March 51, pp. 38-54.

*Leo W. Stach, scientific consultant, Mining and Geology Division.

Analysis of drilling results, 1950.

Type of Well	Footage drilled	Wells Drilled: Produced	Wells Drilled: Abandoned	Wells Drilled: Per cent of success	Initial daily production: Oil (barrels)	Initial daily production: Gas (MCF)	New reserves proved (barrels)
Imperial Oil Co.							
Exploitation							
Oil	110,655	25	10	71	2,887	...	0
Natural gas	14,952	8	1	88	...	460	0
Exploration (oil)							
Outpost	39,311	7	5	58	649	...	8,633,626
New pool test	7,504	2	1	66	34	...	43,150
New field wildcat	36,762	0	10	0	0	...	0
Total exploration	83,577	9	16	36	683	...	8,676,776
Daido Oil Co.							
Exploitation	12,491	2	5	29	35	...	2,500
Exploration							
Outpost (methane)	1,968	0	1	0	0	...	0
Other oil companies							
Exploitation	11,816	15	3	83	18	...	1,000
Exploration							
New field wildcat	ND	0	5	0	0	...	0
All oil companies							
Exploitation	134,962	42	18	70	2,940	...	3,500
Exploration							
Outpost	39,311	7	5	58	649	...	8,633,626
New pool test	7,504	2	1	66	34	...	43,150
New field wildcat	36,762	0	10	0	0	...	0
Total exploration	83,577	9	16	36	683	...	8,676,776
TOTAL	218,539	51	34	60	3,613	460	8,680,276
Methane gas companies							0
Exploitation	56,698	55	0	100	...	1,577	
Exploration							
Outpost	1,482	1	0	100	...	23	ND
New pool test	4,038	2	0	100	...	41	ND
New field wildcat	4,486	4	1	80	...	19	ND
Total exploration	10,006	7	1	87	...	83	ND

ND—No data available
SOURCE: Compiled from data originating from producing companies.

Small extensions were proved by test drilling in Hachimori and Katsurazaka fields, Akita Prefecture, Narahashi field, Yamagata Prefecture, and the Betsuyama extension of Nishiyama field, Niigata Prefecture; a new fault block pool also was proved productive in Kotaki field, Akita Prefecture. Total proved new reserves from these sources, however, amounted to only 140,976 bbl.

The most significant addition to reserves was the contribution of 8,539,300 bbl at Yabase field, which resulted from extension drilling to determine the limits of the productive area of the deep reservoirs, zones 8 and 9, discovered in 1949 and early in 1950. Because sufficient reservoir data are not yet available, the new reserves proved are based on the productivity per well producing from each zone and the number of well locations proved by extension drilling; the factors used in these calculations are scaled down to the minimum expectation so that it is considered that these estimates are somewhat conservative. The productivity of zone 10, discovered early in 1950 at 5500 ft by the deep test Koya R-34, still remains unknown; Koya R-34, which has not yet been repaired, continues to produce about 350 bbl daily from open hole below zone 8 in which the drill pipe is frozen, and no exclusive test of zone 10 has yet been made. Of this total new reserve added in 1950 at Yabase field, about 30 per cent is classified as probable reserve, based on unconfirmed estimates of the productivity and productive area of zone X and the lower part of zone 9. The status of production and reserves from 1945 to 1951 is shown in Fig. 1.

Exploration Surveys

Exploration surveys for oil and natural gas, under the guidance of the Petroleum Resources Development Promotion Council, showed an increase in terms of party-months of 54 per cent over those of 1949 (see table next page). A large percentage of the projects, other than those conducted by Imperial Oil Company, were directed toward prospecting for methane gas, and a considerable part of this effort was supported by local agencies in the prefectures.

All of Imperial Oil's exploration effort was directed toward oil. In Hokkaido, geological surveys by the Imperial Oil were conducted for the clarification of detail on the Sarakishi and Sarakitomanai structures in northwest Hokkaido preparatory to selecting test well locations; exploratory prospecting was conducted in the area north of Ishikari oilfield and east of the At-

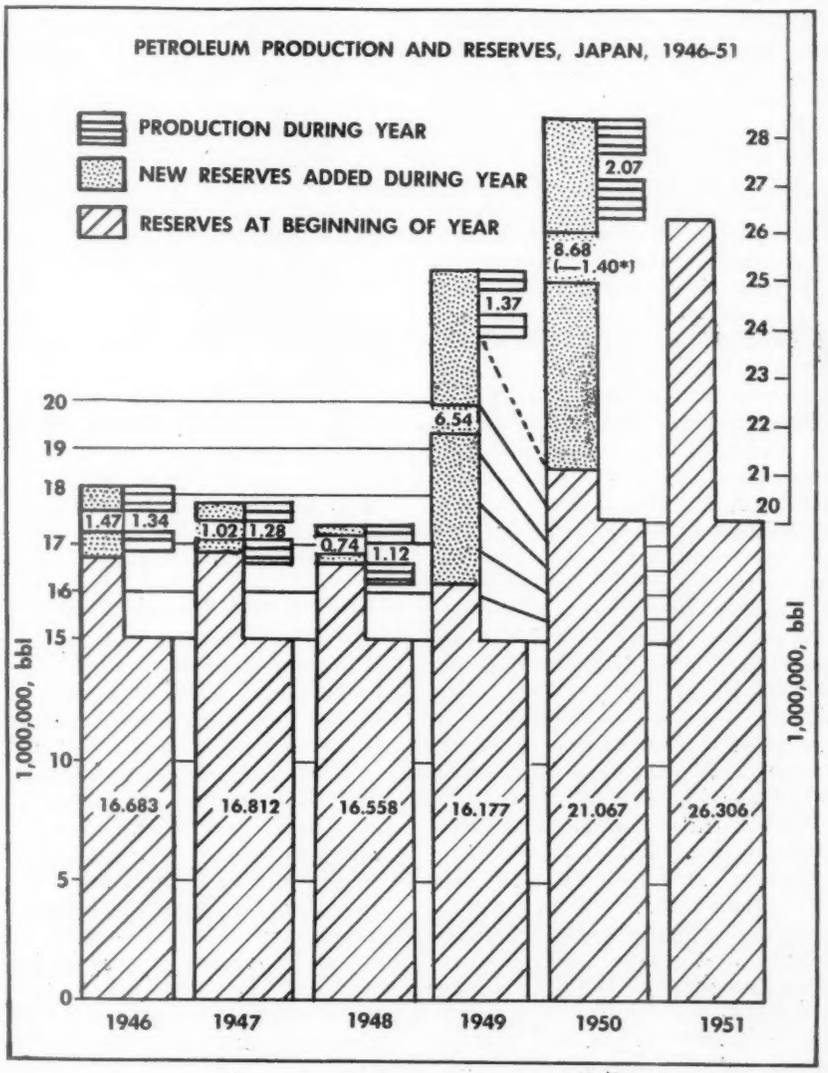

FIG. 1.

*Reduction by recalculation caused by revision of economic limit of recovery in several fields

Petroleum and natural gas exploration surveys in 1950.

Type of survey	Imperial Oil Co.*		Other companies and perfectural offices	
	Project	Party-Months	Project	Party-Months
Geological	33	73.3	21	37.5
Seismic refraction	0	0.0	0	0.0
Seismic reflection	4	13.9	1	2.0
Gravity meter	8	12.5	2	3.5
Torsion balance	0	0.0	0	0.0
Geochemical	0	0.0	0	0.0
Radon	0	0.0	0	0.0
Magnetic	0	0.0	0	0.0
Gamma-ray	0	0.0	0	0.0
TOTAL	45	99.7	24	43.0

Type of Survey	Geological Survey		Universities		Total	
	Project	Party-Months	Project	Party-Months	Project	Party-Months
Geological	4	3.1	3	5	61	118.9
Seismic refraction	0	0.0	0	0	0	0.0
Seismic reflection	2	3.0	0	0	7	18.9
Gravity meter	2	4.0	0	0	12	20.0
Torsion balance	0	0.0	0	0	0	0.0
Geochemical	5	6.0	2	11	7	17.0
Radon	1	1.0	0	0	1	1.0
Magnetic	1	0.6	0	0	1	0.6
Gamma-ray	0	0.0	1	1	1	1.0
TOTAL	15	17.7	6	17	90	177.4

* Includes one geological project of 2.1 party-months and gravity projects of three party-months conducted by Geological Survey for Imperial Oil and five geological projects of 9.3 party-months conducted by University parties for Imperial Oil.

suma fields. In support of geophysical surveys, geological survey was conducted in the areas to the north and south of Yabase field, Akita Prefecture. In Yamagata Prefecture, structure boring was continued to elucidate the detailed structure of the Shonai uplift, concealed by young volcanic detritus. Most of the geologic survey in Niigata Prefecture was directed toward re-examination of the prospects of known structures, and in support of geophysical survey. Extensive gravity surveys were conducted in Akita and Niigata prefectures with the new gravity meters obtained from the United States in 1949; they were used principally in the area north of Yabase field surrounding Lake Hachiro, in the Niigata Plain where intensive search for stratigraphic traps is being continued, and also in the vicinity of the Nishiyama uplift. Seismic reflection was continued in the southern part of the Tsuchizaki structure west of Yabase field, and in connection with detailed prospecting for stratigraphic traps on both the east and west sides of the Niigata Plain; seismic reflection revealed an unusual feature in the Takada plain, in the southern part of Niigata Prefecture, which will be tested by drilling.

Wildcat drilling produced no direct results during 1950, but in Niigata Prefecture valuable stratigraphic data were obtained which will do much toward narrowing the field of search for possible stratigraphic and lithologic trap accumulations. The deep wildcat on the Kawaguchi anticline in northwest Hokkaido, despite the reported exceptionally high gas pressures while drilling, showed only insignificant quantities of gas when tested by selective gun-perforation early in 1951. Because practically no cores were taken from this well much still remains unknown about the structure, which was probably not penetrated more deeply than the lower part of the Miocene Masuporo formation, where a single core taken at about 6000 ft showed a dip of 70 deg. Sarakitomanai structure, to the north of Kawaguchi, is scheduled for testing in 1951. Two wildcats drilled in the northern culmination and the middle part of the Tuchizaki structure, discovered in 1949 by seismic reflection survey to the west of Yabase field, were unsuccessful; facies changes reduced to practically nothing the sand and tuff zones that are productive in Yabase field, and, although zone 7 was found in the northern culmination, structural complexity and steep dips considerably reduced the possibility of commercial accumulations.

Drilling and Production Methods

Drilling efficiency was maintained at the higher standards of efficiency attained during 1949. As a result of the visit of two of Imperial Oil petroleum engineers to the United States early in 1950, the time taken for preparation of locations, transportation of equipment, and rigging-up was considerably reduced. New methods introduced included the following: Use of bulldozers for clearing locations, used for the first time for well sites in Japan at Terayashiki, Yamagata Prefecture, in July 1950; preparation of more portable unitized rigs for the intensive drilling campaign in Yabase field, and increased use of heavy trucks and prime movers for transporting drilling rig units.

The first attempts at dual completion of wells using locally manufactured equipment were not entirely successful, but other attempts will be made to perfect this practice, which is particularly applicable in the deep zones at Yabase field. Considerable progress was made in installation of a gas repressuring unit for the deep zones of Yabase field, into which exhaust gas will be injected after the natural gasoline has been extracted in the new gasoline plant, from the wet gas separated from the deep zone crude.

Footage drilled by Imperial Oil during 1950 was 254,934 ft; the average monthly footage of 21,244 ft was 51.6 per cent greater than that for 1949, and 184 per cent greater than that for 1948. The increase in footage resulted from reduced preparation and drilling time and from the maintenance of more rigs in operation. Part of the increase in footage, however, was achieved at the sacrifice of vital information that should have been obtained from wildcats; in some instances the coring program originally scheduled for such wells was drastically reduced, and in the case of the important deep wildcat in the large Kawaguchi structure of northwest Hokkaido practically no cores were taken below 4000 ft, except for one at about 6000 ft which showed a dip of about 70 deg in what was believed to be, from surface survey, a gentle structure.

Several cases of departures from orthodox drilling, production, and exploration practice, resulting from conflict between policy and expert technical opinion, were evident during 1950. Such malpractices, some of which the conservation measures in the proposed Petroleum Resources Development Law are designed to prevent, will inevitably reveal their detrimental influence in the future.

Research Programs

As a result of the study of micropaleontological methods in California laboratories made by Dr. T. Oinomikado, chief paleontologist of Imperial Oil, during his visit early in 1950, equipment was added and operating methods revised at Imperial Oil's new laboratory. These improvements, completed in October 1949, have effected notable increases in the number of samples treated and examined without any increase of staff. In 1950, 8314 samples were washed, of which 7300 were examined; the corresponding figures for 1949 were 1660 and 1576 respectively. Whereas formerly all paleontological work was conducted at the Tokyo laboratory, in August 1950 two branch field laboratories were

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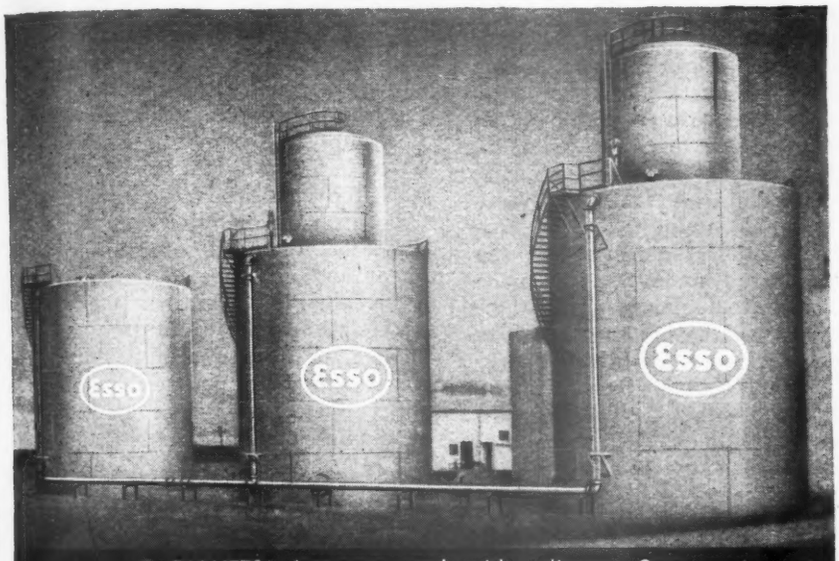

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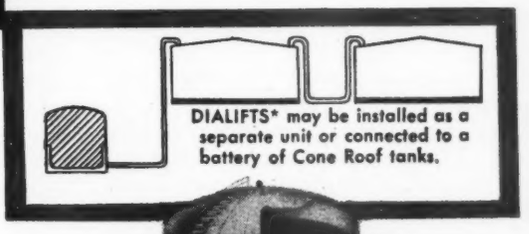
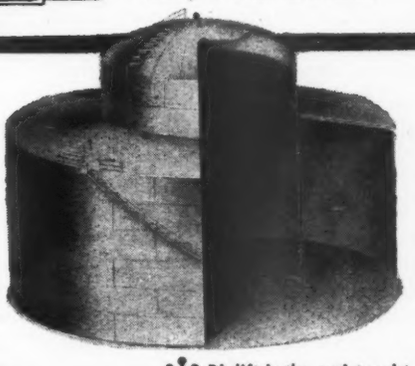


DIALIFTS* may be installed as a separate unit or connected to a battery of Cone Roof tanks.



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established at Akita and Kashiwazaki to make paleontological results from exploration wells more rapidly available, and reduce transportation time and costs.

As a result of detailed geological and paleontological survey in the vicinity of Mobara gas field, Chiba Prefecture, conducted by the Geological Survey of Japan during 1949 and early in 1950, the value of micropaleontological methods in detailed correlation in this area was amply demonstrated. Because of this, the Otaki Natural Gas Company established its own paleontological laboratory at Mobara field early in 1950 and added routine micropaleontological study of well samples to its other research activities connected with development of this gas field.

A major aid to standardization of micropaleontological research in Japan was the receipt of the first copy in Japan of the Ellis and Messina *Catalogue of Foraminifera* which is now lodged at the Institute of Geology and Paleontology, Tohoku University, Sendai. Imperial Oil also is endeavoring to obtain a set for its paleontological laboratory. The first five parts of an *Illustrated Catalogue of Japanese Tertiary Small Foraminifera*, published in such a form that each species figure and description may be cut out to form a standard size card index, were issued in 1950 by Dr. K. Asano, Tohoku University, and Mr. L. W. Stach of Natural Resources Section; this will provide a practical tool to aid research micropaleontologists and assist greatly in coordination of research results by different workers.

In connection with the long-range program of the Petroleum Resources Development Promotion Council several of the compilation map-sheets on the scale of 1:200,000 were published, but most copies are being retained until publication of an accompanying explanatory text is possible.

During the latter part of 1950, Dr. Wilbur H. Somerton of the University of California was assigned to Natural Resources Section as visiting expert consultant on petroleum production engineering, with special emphasis on conservation and the prospects for application of secondary recovery in Japan. The results of his investigations and recommendations are contained in a detailed report, which provides, among other results, a sound foundation for the scientific application of secondary recovery in Japan's older fields.

Early in 1950, experimental water injection through inclined bore-holes drilled into the oil sand exposed in the galleries of Imperial Oil oil mine at Higashiyama, Niigata Prefecture, showed rather promising results. This oil mine provides a ready-made underground laboratory for direct study of reservoir characteristics and behavior of fluids, and it has been suggested that joint studies could be conducted here in collaboration with American research organizations.

Preparations were begun early in 1950 for an experimental water injection project in the shallow zones of the Omonogawa area of Yabase field. The first injection well drilled, however, began to produce about 10 bbl daily, so that the injection plan is now being reconsidered in the light of recommendations made by Dr. Somerton.

The Japanese Association of Petroleum Technologists and the Society of Exploration Geophysicists of Japan continued publication of original research results in their journals; unfortunately, however, only brief abstracts in English are included, owing to lack of funds. The Institute of Geology and Paleontology, Tohoku University, Sendai, famous before the war for the outstanding quality of its paleontological publications, published in 1950 the first two numbers of a new series entitled Short Papers; this journal contains results of research by the staff of the Institute, and the articles are mostly on paleontological subjects.

Economic Trends

As a result of the success of operations during 1949 due to increased production and a high crude oil price of Y1482 per barrel ($4.12), which was computed back from the CIF cost of imported refined products, Imperial Oil declared its first dividend since the cessation of hostilities and the highest (10 per cent) in its 9 years of existence. During the early part of 1950, however, when crude oil began to be imported for the first time since the Occupation for refining on the Pacific coast of Japan, the proposal was made that the official price for domestic crude be based on the CIF price of Y987 per barrel ($2.74) for GARIOA-procured crude. Accordingly, on June 1, 1950 the price of domestic crude to refiners was reduced to Y1,065 per barrel ($2.96) and crude producers were given a temporary subsidy which gave them a total receipt of Y1340 per barrel ($3.72). With the rapid increase in freight rates toward the end of 1950 the average CIF price of imported crude, now imported on a commercial basis, rose to Y1256 per barrel ($3.49). The domestic crude price to refiners therefore was raised to Y1340 per barrel and the subsidy to producers was eliminated.

The rapidly increasing production was more than sufficient to balance the reduced price to producers and, on the first half of the fiscal year's operations, Imperial Oil paid dividends at the rate of 12 per cent per annum. Profits since 1949 have enabled Imperial Oil to reduce substantially outstanding loans accrued in former years. Imperial Oil stock during 1950 fluctuated a little above and below par value (Y50) except for a temporary rise to Y70 at the beginning of the Korean conflict.

The value of the domestic production of crude oil during 1950 in terms of savings of foreign exchange expenditures, based on the CIF price of $2.74 per barrel, was $5,661,000. Without the government financial aid, and the rationalization and modernization of technical operations during the Occupation, the industry by this time probably would have been reduced to the level of a stripper operation producing little more than 1,000,000 barrels annually; it may be said, therefore, that this program of finance and guidance to the industry has resulted in a saving in 1950 alone of about $2,500,000 in foreign exchange for an annual outlay in yen currency by the Japanese Government approximately equivalent to $300,000 in reimbursable financial aid.

Legislative Changes

Following upon the release of Imperial Oil from designation as an excessive concentration of economic power in December 1949, and the reduction of the percentage of government stockholdings from 50 to 23 per cent by the new issue of stock taken up by private subscription in October 1949, government interest in Japan's major oil producing organization was further reduced by the repeal of the Imperial Oil Law on April 1, 1950. As of June 1, 1950, Imperial Oil became a private enterprise and lost many privileges formerly accorded it by virtue of this law, but the former government supervisory powers and controls were eliminated. This legislation has helped to transform the company from its former status as a government liability to a national asset because of the fact that, owing to its large profits, it is now contributing to the national treasury in the form of corporation and other taxes from which, as a government firm, it was formerly exempt.

The new Japanese Mining Law, which had been under discussion for the past few years, was finally promulgated on December 20, 1950, (Law No. 289 of 1950) with the enforcement date set for January 31, 1951. As far as petroleum is concerned, the

most important measure is the special provision pertaining to the holding of exploration leases for petroleum and natural gas. According to this provision, such rights can be held for an initial period of two years; they can be renewed for a maximum of three additional two-year periods at the discretion of the government, on submission of evidence after termination of each two-year period that prospecting has been conducted in a satisfactory manner in the previous period and that further exploration is still necessary.

Study was continued on the revision of the Petroleum Resources Development Law, which now is being expanded to include more detailed measures concerning conservation, and to encourage the introduction of secondary recovery in Japan's older depleted fields by making provision for reimbursable financial aid.

In the pending revision of import tariff schedules, the proposal to place a 10 per cent ad valorem import duty on crude oil, in place of the former prewar specific duty which amounted to about the same percentage, was under consideration by the Japanese Government.

Changes in Company Status

Concurrently with the reorganization of Imperial Oil that has been effected gradually during the past few years, a sweeping change has been made in ownership of stock in the company. In 1946, when the company's capital was Y460,000,000, consisting of 9,200,000 shares at Y50 each, 18 stockholders with more than 10,000 shares held 80 per cent of the total stock; the principal stockholders were the Minister of Finance (50 per cent), oil companies whose producing departments had been merged into Imperial Oil (23.3 per cent), and banks and other financial institutions (6.7 per cent). At the end of December 1950, partly as a result of the capital increase to Y1,000,000,000, consisting of 20,000,000 shares at Y50, the stockholders with more than 10,000 shares numbered 100; between them these 100 stockholders held only 53 per cent of the total stock, the remainder being held principally by individual investors. The largest single stockholder was still the Minister of Finance (23 per cent) and the remaining 30 per cent held by large investors was divided as follows: stockbroking companies (23.5 per cent held between 38 companies, the largest single holding amounting to 5.5 per cent); banks and financing corporations (2.7 per cent held between 18 organizations, with the largest single holding amounting to only 0.4 per cent); insurance companies (1.8 per cent held between 14 companies, of which the largest single holding was 0.25 per cent); private individuals (19) and small companies (3) held between them 2.0 per cent, with the largest company holding 0.27 per cent and the largest individual holding 0.25 per cent.

Because of the great increase in wet gas produced with the Yabase crude, Imperial Oil enlarged its natural gasoline plant and has installed a stabilizer plant to process the natural gasoline into saleable products which the company proposes to retail directly after it has received authorization for a dealer's license from the government.

Among the smaller producing companies few changes took place. The Fuji Mining Company's leases in Hachimori field, Akita Prefecture, were taken over by the Dainihon Oil Company. Imperial Oil's leases in the Sagara oilfield, Shizuoka Prefecture, were transferred to an individual operator. A small company, Midori Sangyo Company, was established to refine the very light crude with high paraffin content, produced in the small fields of the Kitami district. In December, the small refining unit reached Yuchi oil field where it will be installed to refine the crude from Yuchi and other fields, which was formerly railed in drums to Akita for refining. This is the first tangible expression of the trend that is developing among small producers to refine their own crude and, from the increased profits thus obtained, to finance expansion of their crude production.

Otaki Natural Gas Company expanded its production considerably by intensive drilling at Mobara methane gas field, Chiba Prefecture, to a level where it can profitably pipe methane gas to Chiba City and expand its markets.

As a sideline to the development of methane gas production in the Mobara field a number of small companies began to extract iodine in commercial quantities from the saline water produced with the methane gas in Mobara field; these saline waters, produced in the ratio of about 1:3 per volume of methane, contain unusually high percentages of iodine salts.

A new company, Musashino Natural Gas, was established in the latter half of 1950 to explore for methane gas in the areas it holds under prospecting lease northwest of Tokyo Bay; the company's first test well to about 1600 feet is scheduled to start early in 1951. Other small companies were established in other prefectures to promote the development and utilization of methane gas, but no really significant results are yet apparent.

The Outlook for 1951

Production of crude oil during 1951 is expected to show an increase of about 15-20 per cent over that of 1950 as the exploitation of the deep zones of Yabase field is continued. Already in February 1951, average daily production was 6092 bbl as compared with 5180 bbl in the corresponding period of 1950. Because no significant wells were brought to production during the winter period November, 50-February, 51, the peak daily production of 6265 bbl in October 1950 has gradually declined to 6092 in February 1951; a rapid rise in production is expected during the first half of 1951 however, when the ring of highly productive exploitation wells around gas-caps of the deep zones are completed so that gas injection may begin as soon as possible. With proper emphasis on the pursuit of exploration on sound scientific principles, and the conduct of exploitation following recognized petroleum engineering practice, the future of the domestic producing industry in competition with imported crude can be assured.

A considerable increase in production of natural gasoline, amounting to more than double that in 1950, can be expected when the new gasoline plant at Yabase field is in full operation. Natural gas production in the methane gas fields has been close to saturation point for local markets for the past few years, and increases will be dependent on greater utilization and the finding of new markets. Although piping of the gas to other consuming areas has long been proposed by some companies without any action being taken, such plans may be achieved during 1951 if the necessary capital for the relatively large initial outlay for such expansion is available.

The revised Petroleum Resources Development Law probably will be presented to the Diet early in 1951. Among the principal provisions proposed are: The establishment of a formula for recovering the full amount of financial aid given for exploration, from production resulting from successful projects; the introduction of conservation measures based on those operating in the United States; the encouragement of the application of secondary recovery through provision of reimbursable financial aid, and the appointment of the Petroleum Resources Development Promotion Council to advise the Minister of International Trade and Industry concerning administration of the law. * * *

[1]Japanese fiscal year, April 1, 1950-March 31, 1951.

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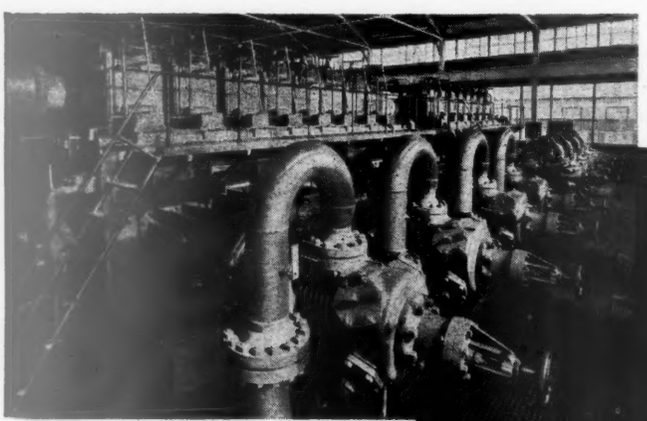

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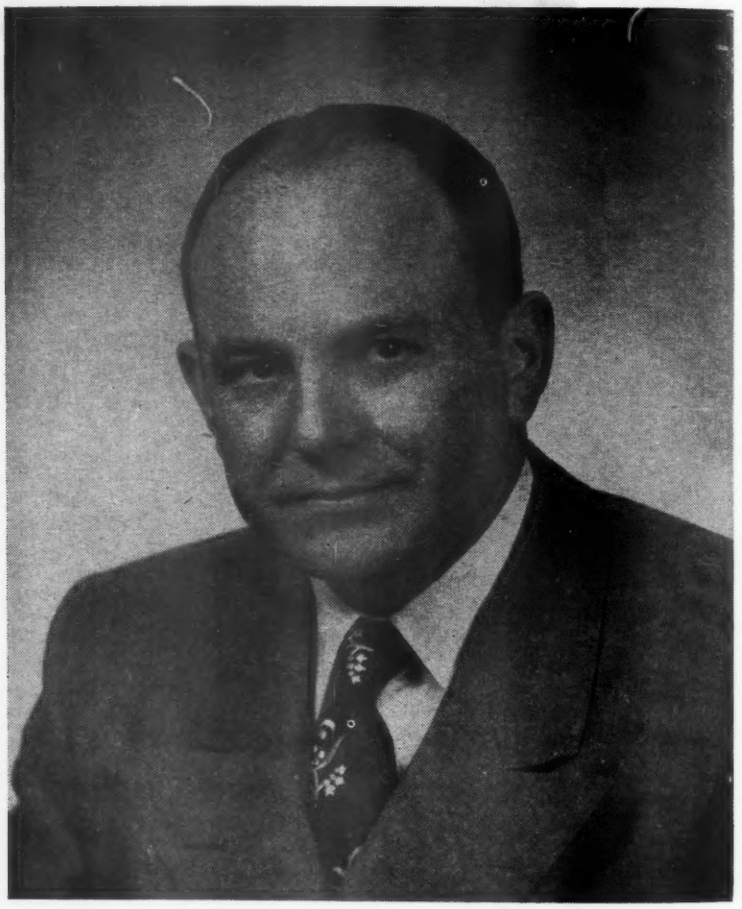
PETROLEUM PROFILE

R. L. TOLLETT
President
Cosden Petroleum Company
and
Western Petroleum Refiners Association



THERE are any finite number of good, effective, permissible, and laudable ways for a man to reach the top. Maybe the number is even infinite; we do not know the answer to that. But we do know that most men who have climbed to positions of power, responsibility, and too-much work have done so each by a different route, all to the same point of vantage.

Way back in 1907, in that Temple, Oklahoma, locality in the state that was fourth in these United States in bringing in petroleum to upset the equanimity of the bucolic, Mid-Victorian way of this country, the land of Indians, of Federal agents, and of riverstream quicksand, there arrived a scion of the Tollett family, yclept Raymond L. Son of an oil well driller, he was transported before he was two years old to the Wichita County, Texas country. He came to Wichita Falls in 1917, year of the start of World War I.

R. L. Tollett graduated from high school in Wichita Falls in 1924, and surviving the end and aftermath of World War I, he went on with teamstering, roustabouting, and such work in the all-pervading oil fields. (These two terms are synonymous with extremely hard work in any man's language.) Meantime through night schools, correspondence, and in collaboration with work carried on from day to day the fields of law, economics, and accountancy were studied intensively, with the result that, eventually, this man was admitted to the Texas as well as the Federal bars and became a full-fledged lawyer in his own right. Not to be cheated in his educational efforts, he completed the training for and was accredited a CPA (Certified Public Accountant) and later was accredited as a member of the American Institute of Accountants. Verily, education for service *is* a matter of service, not semesters.

During this time Tollett was by turns a Panhandle Refining Company secretary, later in the accounting department of Murchison Oil, and Fain-McGaha Oil Companies until 1933. Later he joined the FBI, the accolade for dependable service. He was a member of the Federal Bureau of Investigation as special agent and agent in charge for four years, until 1937. A secretary-and-treasurer of an oil company has no sinecure, and that was the job Tollett accepted with Wrightsman Oil, at Fort Worth, in 1937 to move up to the same job with Cosden Petroleum two years later.

Helmsman for Cosden was the job for which he was evidently slated; executive vice president was his portion in April, 1940, eleven years ago. Things moved fast then, and in June 1940, he was made president and general manager of this fast-moving enterprise, a job that appears, in the terms of the old country doctor, "to agree with him." He finds fault with the solar system—not enough hours per day. As a guerdon of dependability and confidence, he was elected in March to be the president of the Western Petroleum Refiners Association. During the years that have intervened, he has been officer and director of several organizations, always in positions requiring judgment and the ability to foresee the direction industry and the national government in world activities is carrying this, the most important industry of modern time. Ray Tollett lives out at Big Spring, Texas, in the geographically great open spaces, which is headquarters for his company. He has a daughter and two young sons to see to it that no grass grows on his mental street and to carry on the record built and building by "the old man" still a very long way from warranting the adjective "old."

Why Limit Oil Exploration and Development?

ALTHOUGH more crude oil is still being found and added to our proved reserve each year than we are currently using, the total proved reserve is diminishing in terms of years' supply at the present rate, or the ratio of U. S. proved reserve to annual domestic demand.

In 1919, for example, the proved reserve was about 6,700,000,000 bbl, or **14.7 times** the total demand of 438,434,000 bbl during 1919. This ratio diminished to an all-time low of about **9.4 times** the demand of 805,062,000 bbl during 1924. It increased gradually, reaching a peak of about **13.5 times** the demand of 938,757,000 bbl during 1932 (after the discovery of the East Texas field). This ratio then diminished to about **10.4 times** the demand of 1,224,748,000 bbl during 1936.

A stepped-up exploration program during the next few years resulted in the discovery of new fields and extensions to old fields, which increased the proved reserve to about 19,024,515,000 bbl in 1940. The ratio then reached about **12.9 times** the demand of 1,457,086,000 bbl during 1940. Since then, the ratio decreased to about **10.6 times** the demand of 1,955,668,000 bbl in 1945, and it increased to about **11.6 times** the demand of 2,500,000,000 bbl in 1950.

The slight increase in this ratio from 1945 to 1951 was the result of almost doubling the number of exploratory wells drilled during a period when crude oil prices were raised from about $1.21 to $2.61 per bbl . . . This slight increase was the result of "plowing back" as much as possible during an inflationary period. Crude oil, like other commodities, became more valuable, and the producers stepped up their efforts to find more of it with the revenue they received from production.

Now, in the face of the greatest increase in the demand for more crude oil and natural gas liquids, the Federal Government has frozen crude oil prices, thus limiting the amount of income that producers will have available for exploration. It is unlikely that oil producers will be able to continue the stepped-up search for new crude oil reserves at present high costs without receiving more for their production.

Unless oil producers receive more revenue from their production, so that they can continue to increase their exploratory and development efforts, how can the government expect anything else but a declining ratio between proved crude oil reserves and production? It now takes more capital than ever before to find and develop new crude oil reserves, and we need to find and develop more reserves now than ever before to stay up with demand.

A reduction in imports would confront the nation with a serious shortage of oil to meet the needs of an increasing peacetime demand, and might result in a grave crisis in the event of an all-out war. The necessity exists now for seeking an increase in the price of crude oil. Who dares to say that present prices are adequate to finance the finding of enough new crude oil to supply the increasing demand? Why limit oil and gas exploration and development now?—K. M. F.

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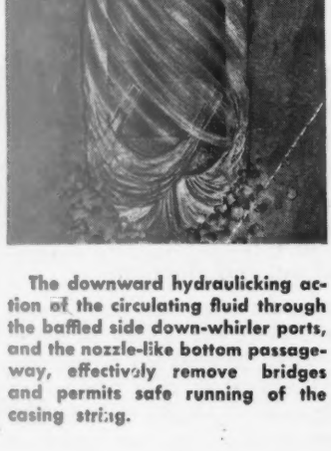
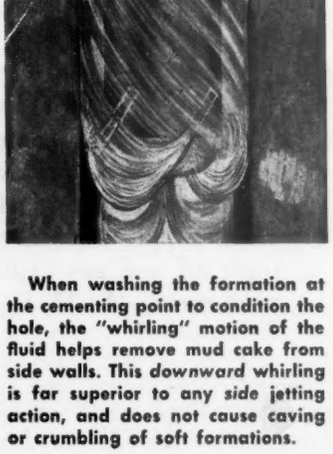
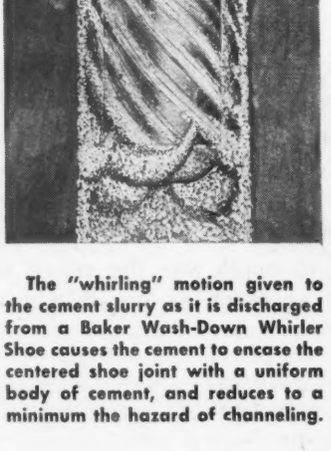
Study the illustrations below for visual proof of what "whirling" means to you.



The downward hydraulicking action of the circulating fluid through the baffled side down-whirler ports, and the nozzle-like bottom passageway, effectively remove bridges and permits safe running of the casing string.



When washing the formation at the cementing point to condition the hole, the "whirling" motion of the fluid helps remove mud cake from side walls. This *downward* whirling is far superior to any *side* jetting action, and does not cause caving or crumbling of soft formations.



The "whirling" motion given to the cement slurry as it is discharged from a Baker Wash-Down Whirler Shoe causes the cement to encase the centered shoe joint with a uniform body of cement, and reduces to a minimum the hazard of channeling.

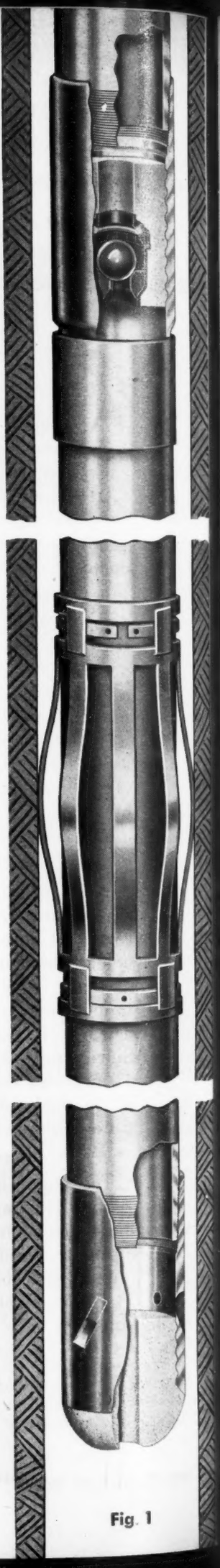


Fig. 1

Radioactivity Well Logging Anomalies

Valuable information on phenomena of radioactivity well logs reveals how they may be interpreted and put to use

JOHN L. P. CAMPBELL*

THE dictionary defines an anomaly as "a deviation from normal; an irregularity; abnormal." Abnormal responses, or anomalies, appear from time to time on radioactivity well logs. A study of logging experience and a thorough understanding of the physical and chemical reactions that influence the logging instruments make it possible to interpret correctly many of the anomalies and thus make them of practical value.

The information in this article is based upon the experience and interpretation of well logs throughout the Gulf Coast and West Texas-New Mexico areas. The diagrams are a selection of logs made into composites to better define and clarify points discussed in this paper.

Radioactive Crusts

The most widely used survey of a borehole to date is undoubtedly the electrical log, and the operator is benefited through the experience of using not only his own logs, but copies of other well logs. As a result the normal reaction for a sand on the potential or resistivity curve has become somewhat of a "standard unit" for interpretation.

The radioactivity log is similar in appearance to the electrical log. This is possibly more true of the radioactivity log than of other borehole surveys. The gamma ray curve, in general, resembles the potential curve, and the neutron curve resembles the resistivity curve. This similarity of appearance between the electrical and radioactivity logs is of material assistance in the interpretation of both logs. This is common knowledge. It is the unusual that will be discussed in this paper.

A particular difference in some areas, especially when comparing the gamma ray to the potential curve, is the fact that the gamma ray curve is measuring natural radioactivity, and due to the contamination, or presence of radioactive materials in the formation, does not always appear similar to the potential curve either in whole or in part.

On a newly-drilled well, a gamma ray survey generally will show a sand as a low radioactive value and, for comparison, may be directly superimposed or correlated with the potential curve of an electrical log.

In many cases, however, after the well has produced many years from a particular zone, and in time has produced tremendous quantities of water, necessitating work-over, a gamma ray survey will show an extremely high radioactive intensity opposite the sand of interest, which is caused by a radioactive crust in the perforated zone.

The development of such crusts is usually associated with a reduction in reservoir pressure and the production of water. Formation waters and oil, supersaturated with salts of radioactive materials release the salts, which are deposited to form the crusts.

This radioactive crust may be both on the inside and the outside of the casing, as well as in the casing perforations. This crust, which is somewhat amber in color, is extremely permeable and porous, and is sometimes of the order of 1/16 to 3/16 of an inch in thickness. The crust is built up as a deposit of radioactive minerals as a result of the salt water reacting chemically with iron oxides of the casing. The deposits reduce the size of the perforated hole and account, in many cases, for the decrease in total barrels of fluid produced. An increase in perforation size due to cutting action by sand is expected where such deposits are not made.

Many wells, in being worked over, require the pulling of a screen or liner. Screens have this radioactive crust on the inside and outside of the wire wrapping. Liners are pulled to the surface in a similar condition. This crust is normally more radioactive than a standard gamma ray sensitivity test bottle. It is not possible to provide a normal survey by scraping off the crust on the inside of the casing, because of the crust that remains on the outside. The outside crust is continually being increased by deposits from the formation. With liners or screens, however, this is readily corrected by pulling the liner or screen and under-reaming or cleaning-out effectively.

A particular benefit in interpretation of these radioactive zones is the fact that one may determine the most permeable portions of the sand, because the higher intensities certainly indicate the greatest productivity. The natural sand, or lower values within the zone, where liquids have not been produced, would remain normal when compared with the electrical log or interpreted at face value. It is quite surprising from time to time to notice that, although a sand may have been gun-perforated in a given zone, the entire sand has not been drained.

Changes or differences in measurements at the time the well was drilled and completed through gun-perforations, when compared to a work-over survey, often show a section of sand above the perforated zone with a definite shale break before reaching the top of the perforations. A squeeze job and re-perforating often rejuvenates a well that would have been abandoned in the same sand. Zone A of Fig. 1 shows a sand that is radioactive to the gamma ray curve but still normal on the neutron curve. The top and bottom portions of the sand are highly permeable and have produced liquids. The center zone is unaltered,

*Division sales geologist, Lane-Wells Company, Houston, Texas.

EXCLUSIVE

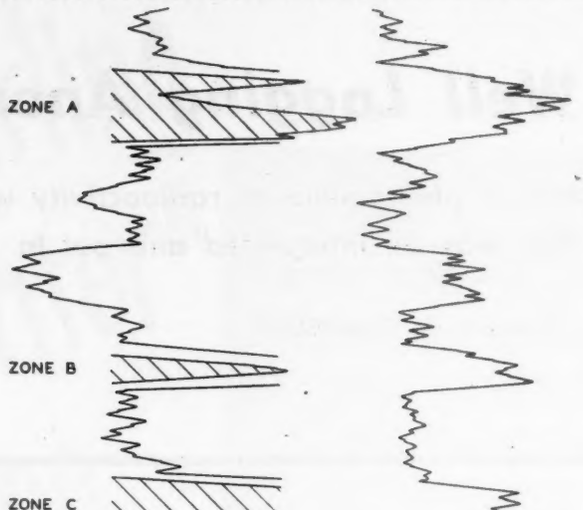


FIG. 1. RADIOACTIVE CRUSTS VS RADIOACTIVE SANDS.

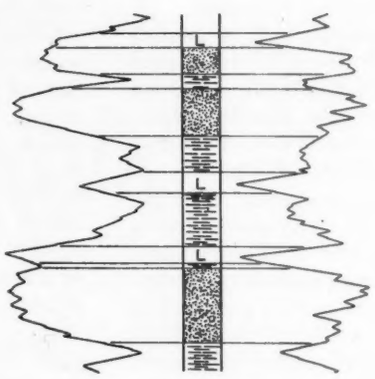


FIG. 2. LIGNITE VS SAND.

has not produced, and in all probability, when comparing the two curves, is a dense or hard streak separating the two fluid sections in the top and bottom.

A well that has produced on a packer, with the packer set above the sand of interest, will generally show the higher radioactivity value in the sand perforated. A well that has produced with open-ended tubing will have the disconcerting factor of radioactive deposits in the solution in the annulus between the tubing and casing. It may, therefore, show the deposits along the casing to the surface. The radioactive salts collect in spots, and casing collars, to a relatively great thickness, thus making it practically impossible to render an interpretation at face value without the assistance of additional records. These highly radioactive zones are not necessarily opposite sands or shales, but are the results of solution deposits on the pitted or weaker sections of the pipe.

This same anomaly is generally found in limestone areas where wells have produced through a slotted or perforated liner or screen. It is found that the effects of radioactive crusts are a reaction of the saline water following the production of oil, and are directly associated with the casing program. This, of course, is not true on wells that are completed in open hole.

In Lower Frio producing wells where a combination radioactivity survey may have been run, it is a matter of experience and practice to say that Lower Frio sands are quite highly radioactive due to bentonitic or glauconitic material, and marine shaly material. Potassium deposits within these sands create extremely high intensity values on the gamma ray curve. Normally, bentonite is not radioactive, but the association of potassium by chemical analysis to these sands justifies the use of the word rather freely, because of the siltiness or colloidal particle material as interstitial bonding of the sand grains.

Normally described as "fine-grained sand" in a geologist's report, these sands caused problems in the initial completion of the well. This colloidal material may have been found in excellent cores, but not in drill cuttings. It is generally agreed, however, that the drilling mud frequently decreases the potential test of the sands, due to the swelling action of the bentonitic material.

In many cases, operators will spot oil opposite radioactive sands prior to gun perforating to eliminate the water against the formation and to bring in the wells with less trouble than those gun-perforated with mud in the hole opposite the sand of interest. Frio well logs do not exhibit a normal appearing gamma ray curve, due to the extremely small difference in radioactive values. For example, a Miocene log would have a scale comparison of 1 to 10 radioactive units, thus providing clear definitions between sands and shales. The Frio sands, being very silty and radioactive throughout the section, have a comparison between 9 and 10.

This extremely small comparison does not define sand and shale clearly, and the use of the neutron survey is desirable to segregate or delineate them. It is possible, however, to render an interpretation for total thickness and net thickness with producible fluid sections within the sand by subtracting the shales in sands of interest.

Fig. 1 exhibits two Frio sands, namely Zone B and Zone C. Zone B may be interpreted as a glauconitic sand that is radioactive from top to bottom, for the larger grained material of the glauconite in the sand does not decrease porosity and permeability. It is believed that glauconite sands, though extremely high values on the gamma ray curve, will have a thickness equal to comparable points of the neutron curve. Zone C, however, is a bentonitic or marine material sand that, through deposit and oscillation of water, has affected a portion of the shale below and above the sand of interest and is generally thicker on the gamma ray than comparable points of the neutron curve. It is this sand that has been decreased in permeability and porosity by the interstitial matter, and should be tested with oil opposite the perforations. This thought is submitted by the writer as a current conception. Cooperation between various producers and the service company is providing a greater wealth of knowledge that may affect this concept.

Lignite

Lignite is defined as a brownish-black coal in which the alteration of vegetal material has proceeded fur-

ther than in peat but not so far as subbituminous coal. The high content of chemically combined water in lignite, plus this vegetal material, which is an over-abundance of hydrogen directly affecting the neutron curve, exhibits the only known radioactive values interpretable below the average shale line. As this is natural and is repeatable on any survey, an interpretation is rendered directly on lignite and defined as such, although the lignite streaks may appear on top, within, or at the bottom of sands. Experience is generally in Wilcox producing areas, and is true in the Wilcox producing wells of Mississippi, Louisiana, and East and Southwest Texas. Lignite beds have extremely high resistivity values and practically no potential on an electric log. Lignite appears as sand on a gamma ray curve, and a value lower than shale to the neutron. Fig. 2 illustrates the various effects of lignite. At the top of the diagram, for example, a total sand thickness would be indicated other than described because of the reaction of lignite to sand. The neutron, in separating lignite from sand, shows the true thickness of the lignite and the true thickness of the sand. The lignitic portion is defined as "L." In the center of the diagram, a streak of lignite exists without sand, and shows as a low value to the gamma ray and a lower than shale value on the neutron. On the bottom portion of the diagram, lignite above the sand is separated from the sand by a thin shale. The general practice of producers is to correlate the simultaneously - located casing collars of the gamma ray survey to the lignite beds on the neutron curve and gun perforate a few feet below these streaks to obtain a water-free test.

Bentonite, Glauconite, Organic Marine Shales

The radioactivity survey measures natural radioactivity and will vary in intensity values throughout shales. The darker the material, in general, the higher the gamma ray values, and the higher the potassium content, the higher the gamma ray values. Bentonite, though not radioactive itself, is associated with fine silts that do contain high potassium content, resulting in extremely high gamma ray values. Marine shales respond similarly. The neutron, however, records a normal shale line because it is interpreted in hydrogen content.

The marine shale portion of Fig. 3 shows the natural shale as the average value vertically on the gamma ray curve, whereas the bentonitic or organic material is shown by the higher intensity values. The neutron on the right side responded normally regardless of the radioactive material.

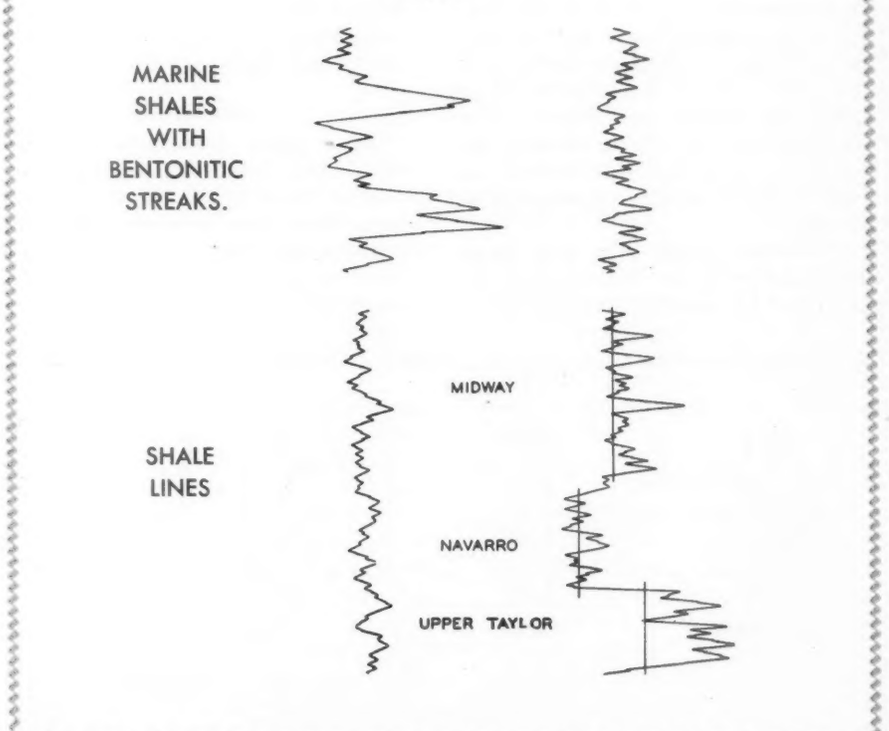
Geologically, however, the shale lines may be used and the portion of an East Texas group of surveys is compared in the lower diagram of Fig. 3. Depending upon the calcareous material and the hydrogen density of the shales, the neutron curve responds to clear-cut breaks between the continuous series of Midway to Navarro to Upper Taylor. Logs that are interpreted are done so with this neutron reaction in mind. The writer does not pretend to define the character of the Midway, Navarro, or Upper Taylor, other than to state that the Midway is generally a light-colored, ferrous oxide material; whereas the Navarro is a glauconitic greenish silty material; and the Upper Taylor is a dark calcareous, dense series of marks and clays. It is the use of the neutron curve and proper interpretation that justifies exploration mapping on facies changes or depositional features that assist the operator in determining locations of stratigraphic traps.

Casing

When a radioactivity survey is run in a single full string of pipe, the overall picture will exhibit a straight base or shale line from top to bottom. If, however, the casing has parted or there is an over-lap between a liner and the long string, or if the casing is set in open hole, the neutron and the gamma ray will frequently shift. A full gage hole and a long string of casing do not justify other than standard interpretation. When the casing is parted, and has dropped, however, as sometimes happens, anomalies appear on the radioactivity survey. It is not always true that the gamma ray curve will shift, but the neutron will have a change of approximately 30 per cent in intensity value, such that the parted section of casing will cause the curve to shift radically to the right in almost a flat line at the top of the lower section, and shift back sharply to normal at the base of the upper section. While this does not alter the normal logging or interpretation of the curve, the information is extremely important in well cementing or completion practices. It is not infrequent to have a survey where this problem exists. It is not infrequent, either, to have a survey on a well where this condition exists with a packer liner hanger run within the casing which, of course, changes the character of the curve materially. All of this information is properly noted on the survey.

When casing is run to a given depth and cemented, and a rat hole, or reduced hole, drilled below the casing seat, it is the general practice to run a screen or liner. The borehole effect

FIG. 3



plus the casing program, will show on the neutron curve. The greater the distance of the formation to the neutron instrument, the greater the shift of the curve to the right. Consequently, it is frequently possible to determine, through a neutron survey, whether the well was drilled with a full gage bit or whether two bit sizes were used.

Fig. 4 shows three wells in the top diagram. The center shows a full gage bit size with parted casing, and the neutron average shale line is vertical. The right hand diagram shows a liner inside casing where the top of the liner shift is greater than the base of the casing shift. This is entirely due to the distance of the instrument to formation. The casing program again does not alter normal logging and interpretation to distinguish sands or shales behind the liner and casing as well as opposite just the liner or the casing.

In open hole to casing the gamma ray does not generally respond to the casing seat, but the neutron curve shifts to the left due to the shielding effect. Casing seats can usually be situated within 6 in. The amount of shift is entirely due to the size of the open borehole relative to the borehole and casing. It is through this casing seat and liner problem that, with proper interpretation of radioactivity well logs, sands have been completed or recompleted. The sand may be wholly, or in part, behind one or two strings of pipe.

The neutron curve shifts sharply to the right at a well fluid level similar to the reaction to a change in borehole diameter. Fig. 4 shows this reaction. The neutron curve shifts because some of the neutrons are absorbed by the fluid column. Such shifts do not affect the normal indications of formations, etc. It is this shifting that gave rise to the fact that neutron surveys could be used to locate gas/fluid levels.

Although parted pipe may be determined by the use of a neutron survey, it is not possible to locate a hole in the pipe, or a series of holes, such as perforations, because of the existing metal surrounding the instrument. In other words, the slight lack of metal caused by the hole does not have a significant effect upon the neutron values. In contrast, parted pipe leaves no metal, and the neutron curve shifts sharply. Cases are on record where the weight of the pipe is changed in a long string from light at the surface to heavy at depth, and this additional weight of pounds per foot changes the sensitivity and shift of the curves. The less the weight, the higher the values on the neutron, and the average shale line shifts slightly to the right.

The radioactivity instruments have magnetic casing collar locators, which simultaneously electrically locate casing collars while logging the formations, and provide down - the - hole bench marks as necessary markers for gun perforating and testing. The entire thought is, of course, to eliminate question of measurements, and has, to date, completely satisfied this purpose. Under severe well conditions it is not always possible to locate all of the casing collars. Often when the cement is drilled prior to testing, a full gage bit is not used, and the cement sheath in the casing holds the collar locator away from the pipe making collar location difficult. When the well is cleaned and reamed, casing collars usually can be located with 100 per cent efficiency. The fact that cement exists in each collar does not prevent the location of the collar. The operator can check his pipe tally accurately against these casing collars. Where a tally is not available, the operator can determine the length of each joint from total depth to surface.

Gas Sands

In a paper previously published, the neutron curve was exploited as a tool to locate gas and gas/fluid contacts. Since then, however, many more surveys have been run and the results tend to alter this conception. Gas sands are hydrogen-bearing sands, although the hydrogen density may be less in cubic measurement than the hydrogen density in liquids. Shallow gas sands of low pressure show extremely high neutron values, whereas high pressure sands show normal or fairly low neutron values; therefore, it is not always possible to interpret a neutron survey in gas or liquid unless the immediate area is known. It is now accepted that the lower the pressure, or the lesser the depth, the lesser the hydrogen density, and the greater the neutron intensity values. The greater the pressure, or the greater the depth, the greater the density, and the lower the neutron reading. This is particularly interesting because water not being compressible, and gas or distillate being compressible through pressure and depth, may respond as liquid saturation. It has been noted on many occasions that high pressure, high gravity distillates or gases have a lower neutron value than known water sands, and that low pressure, low gravity oils or distillates have values higher than an average water sand. It is not at all impossible to believe that soon diagrammatic charts will be available to determine the difference between gases, distillates, oils, or their mixtures.

Fig. 5 has three sands for discussion. The top sand is a broken series of sands and thin shales as shown on the gamma ray curve and a neutron reaction of twice the magnitude. Gas exists in the upper three-quarter portion of the sand, separated by shales, with a liquid contact as noted. This can be interpreted as a shallow, low pressure, low gravity gas with a fluid contact of oil or water. However, at great depths and pressure, this also would be a dry gas with a distillate contact. In this case, the gravity would be extremely high. The intermediate sand on the diagram is a high pressure, high gravity gas compressed to a liquid, and is comparable to any fluid sand on the log. The lower sand is a clean sand from top to bottom, and contains a low pressure gas throughout.

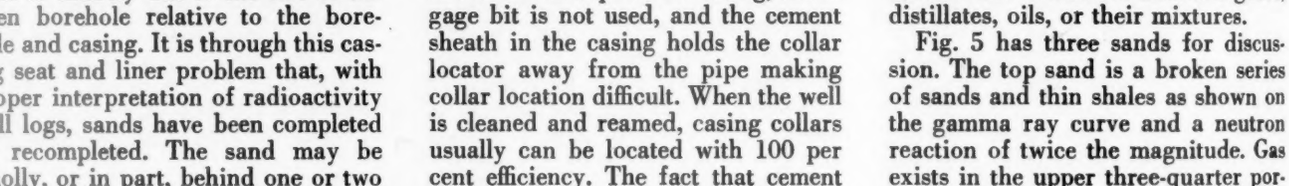


FIG. 4. CASING.

The writer is of the opinion that the surveying time versus drill-out time for initial completion, or the surveying time to squeeze time, has no bearing upon the neutron reaction in a high or low pressure gas sand. This opinion is based entirely upon consideration of depth, pressure, gravity, etc. Borehole fluid invasion, or water loss, therefore, is no longer considered a major factor in the proper evaluation of neutron intensity.

Instrument Description

Both the gamma ray and neutron instruments have the same physical dimensions—being 10 ft long, 3⅝ in. in diameter, withstanding approximately 350 deg temperature, and 12,500 lb bottom hole pressure. The gamma ray instrument has a 3 ft ionization chamber, and at a normal speed of logging between 30 and 40 ft a minute in the Gulf Coast area and 75 ft a minute in West Texas-New Mexico areas should have an interface depth response slightly longer than the ionization chamber, at a clean sand/shale contact. This is shown at the top of Fig. 6. The mid-point would, therefore, be 1½ ft. Thin shales or thin sands having a thickness equal to, or less than, the length of the ionization chamber cannot exhibit full travel of the pen, and must be justified through interpretation or comparison with the comparable neutron curve. This thinness versus length of chamber is shown in the shale section in the top sand.

The neutron instrument has a 10 in. ionization chamber, and the pen travel is much flatter, or sharper, than the gamma ray curve between low and high intensity values at a shale/sand contact. Its mid-point is in the order of ½ ft. Because of this shorter length, the neutron will have a lower value toward the shale line in thin shales, and higher in thin sands, to justify interpretation with the use of the gamma ray curve. Because the neutron curve measures hydrogen density, thin dense zones are shown as higher values to the right of the curve trend as marked in this top sand. It further separates or evaluates net sand thickness to hard streaks, or shale. The intermediate thin sand in the center of the top diagram shows a sand of lesser thickness than the length of the gamma ray ionization chamber, but which appears natural to the neutron as a responding complementary curve. The lower sand of the top figure is a clean sand with fluid and dense streaks only. There are no shales. The fluctuation throughout the length of the sand is nothing more than statistical error found on any radioactivity survey, and which should be, in proper logging, an absolute minimum in the order of 3/16 to ¼ in. amplitude.

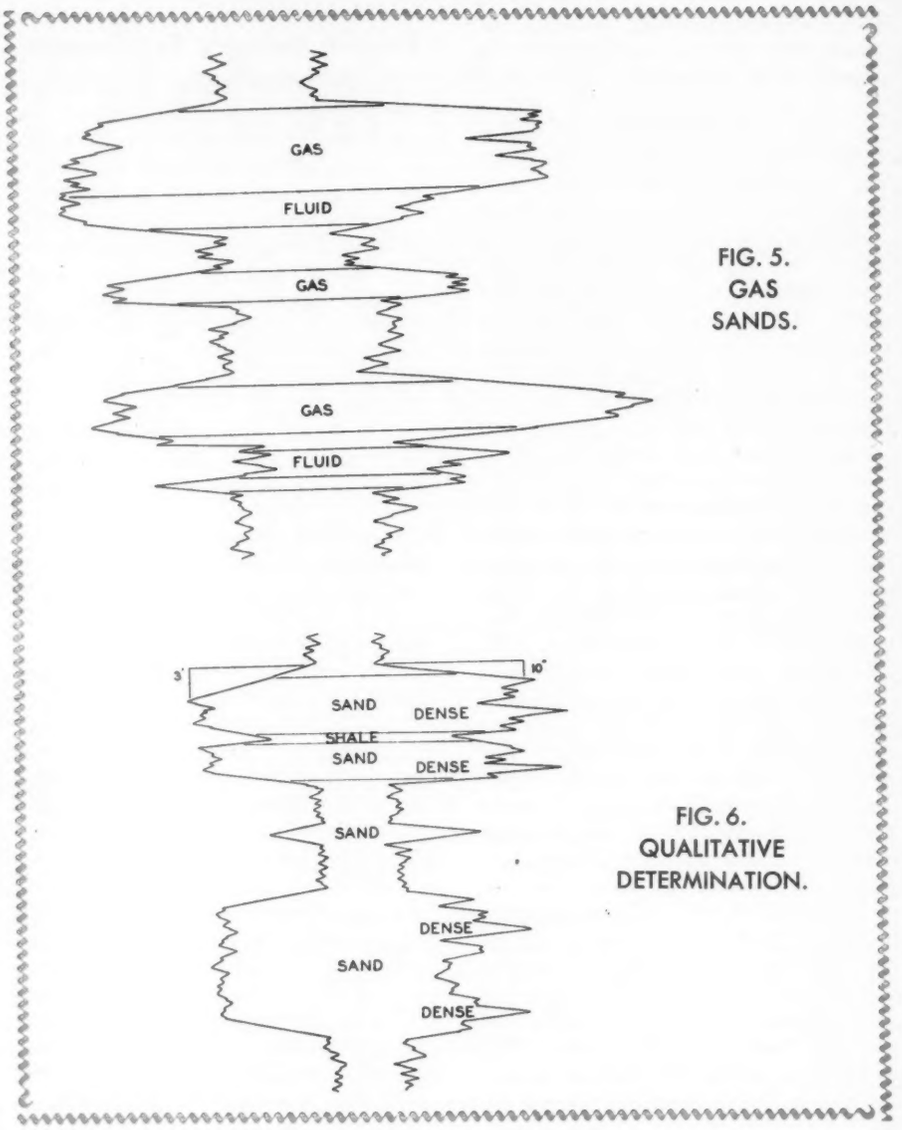


FIG. 5. GAS SANDS.

FIG. 6. QUALITATIVE DETERMINATION.

Radioactivity surveys in the Gulf Coast sand areas are interpreted qualitatively, and absolute measurements or interpretations are not rendered at this time because of formation factors that are as yet uncalibrated and which therefore do not permit porosity evaluation. It is hoped that these will be eliminated shortly, and, if so, certainly will justify a sequel to this paper.

In the limestone, or cemented sandstone areas of Kansas, Oklahoma, West Texas, et cetera, quantitative interpretations are readily rendered. These quantitative interpretations are made in wells following diamond coring, or in which pipe has been cemented in a diamond cored hole. Porosities within, and less than, one per cent accuracy to a core analysis are determined through a quantitative calibration of a radioactivity survey. This subject has been widely exploited and is now a standard practice. It is mentioned in this paper to account for the reaction of liquid filled porosity to sand or lime. As shown in Fig. 7, the gamma ray curve and the neutron curve response is plotted as lineal measurement of pen travel. The neutron curve responds exponentially to the liquid-filled pore space. The lineal neutron curve deflection measurements are plotted versus porosity on semi-log graph paper for a given bore hole size. Any other log of a well drilled in the field can be calibrated in terms of porosity within the limitations of bore size and casing programs.

Correlation

From the previously mentioned calibration, it is entirely possible that geologic mapping will undergo changes. Where electrical logs or core analyses are not available, the radioactivity survey is the only means of obtaining a stratigraphic picture for mapping, and due to the zeroing equipment of radioactivity surveys,

facies change, faulting, lensing, and pinch-outs, will, of course, alter the preconceived sub-surface viewpoints.

Exploitation

Too often radioactivity surveys are not of sufficient length to give maximum values. The operator, primarily interested in a sand or sands, is not willing to fortify himself with a sufficient length of survey for exploration study. Anomalies, as mentioned in this paper, are now becoming mapped features, and in some fields the entire mapping is done on marine beds or bentonitic beds that exist throughout the field. From these maps, drilling or work-overs are accomplished, resulting in new production of oil or gas. Radioactivity surveys provide a geologic, engineering, or production evaluation of sands and limes for short range or long range correlation. Due to the precise characteristics of some formations in recording, only one log need be interpreted in relation to faulting. This is particularly true in the Balcones fault area where the faulting exists in the Austin chalk. The Austin chalk, usually of great thickness, is divided into unit components of chalk and shale. These components are characters that may be depended upon for subsequent production. The fluid zones in the chalk, separated by dense streaks or shales, can be selectively gun perforated for oil production. Of course, structural position must be favorable. The thought is advanced because wells, heretofore, have been abandoned in the Edwards lime without testing any upper formation.

Radioactive Cement

When a well is drilled, a caliper survey is run to determine the hole sizes in relation to the amount of cement necessary to have a height above any zone for testing. After the casing has been run and cemented and a production test is made on any sand, it is difficult to determine the travel of the cement of a squeeze job without the use of a tracer. A means of tracing these subsequent squeeze cementing jobs is by the use of radioactive casing compound No. 2, which is available at the present cost of 76 cents per pound. Normally, 1/3 lb of compound per sack of cement is used, which provides a suitable anomaly of a subsequent gamma ray survey to an original log to determine the vertical and mass travel of this ad-mixture. It is the normal practice, however, of the producer to drill the plug with a bit smaller than ID gage, which leaves a sheath on the inside of the pipe. This sheath on the inside plus the travel of cement outside the pipe, causes the entire section of the cemented zone to be to the right of an average vertical shale line on the log. The top of the cement is determined by superimposing the subsequent run on the original and noticing the point at which they superimpose. Large anomalies to the right in the section cemented indicate bulk travel or lateral displacement. The largest anomalies are, of course, opposite shales that have washed out or, by means of fracturing bedding planes, have thin layers of cement. This cement bond from fractured shales has been cored in side-tracked holes. One school of thought is that cement does not set up opposite oil sands; yet, in practically every case where radioactive cement has been squeezed in the hole, a large anomaly appears opposite the sands as well as the shales on a post survey. Where more than one squeeze job has been performed on a given zone, each of which has radioactive material added following dry drill-stem testing a displacement vertically and laterally of the cement still shows.

Considering a large group of surveys for this particular application, a few averaging statements may be made. It his frequently been found in this region that 2/3 of the cement travels up the hole and 1/3 down the hole from the zone of perforation. This, of course, considers the fact that the well is not squeezed on bottom. It is not infrequent that most of the cement travels entirely up the hole and, in a few cases, all of the ad-mixture traveled down the hole.

The use of radioactive cement does not answer a question of channeling. The thin travels of fluid without cement bond can not be determined by this type of survey because of the sphere of influence of the gamma ray chamber. The only determination is that additional displacement of cement has been made in a non-calibrated vertical and lateral movement.

The increased speed of logging, the development physically and electrically, and the experience and knowledge on the part of the service company directly associated with the producer, makes it possible for the writer to present this material and make it available to all interested readers.

* * *

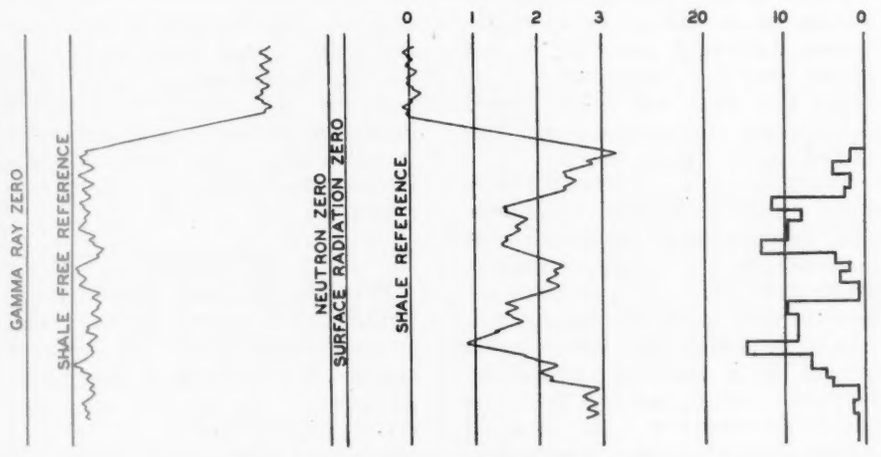


FIG. 7. QUANTITATIVE DETERMINATION.

The Oil Industry Can Supply Oil Demand, Says Morgan

Responsibility of the oil industry is increasing, "whether for peace or for war," and it is the job of geologists to "back up the industry by finding its raw products as fast as required."

This was the word given more than 2000 conferees at the annual American Association of Petroleum Geologists convention in St. Louis by Frank A. Morgan, newly installed president. Morgan is vice president of Richfield Oil Corporation in charge of exploration.

"I believe the sensible course will be to continue to find and produce oil," Morgan said, "regardless of higher costs."

"With a healthy oil industry there can be no doubt that the technological know-how will be developed to handle oil shale or the synthesis of coal whenever the necessity arises. That's just natural evolution in our competitive system," he added.

"It will be a long time before the need or the economics will justify the abandonment of our present system in favor of a government operation seeking oil products in quantity from shale or coal," Morgan declared.

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Submersible 1800-Hp Drilling Barge Operates in Corpus Christi Bay

G. OTIS DANIELSON*

The 11-ft deep hull of Kerr-McGee's new 45 by 211-ft drilling barge with its 136-ft derrick rests on the bottom of the open waters of Corpus Christi Bay off Mustang Island, where it is engaged in drilling 8000-ft wells for Sunray Oil Company.

Drilling mud circulation is provided by the two slush pumps in the pump room on the main deck of the barge. The 7 ¼ by 18-in., 450-hp pump is in the foreground, and the 8 by 20-in., 600-hp pump is shown at the upper left.

A NEW 15,000-ft drilling rig, mounted on an 11 by 45 by 211-ft submersible type hull is now operating for the Sunray Oil Corporation in the open waters of Corpus Christi Bay, off Mustang Island, Texas. Kerr-McGee Oil Industries, Inc., of Oklahoma City is the owner of the new drilling barge, and is the drilling contractor on the 8000-ft wells that are being completed for Sunray in this area.

This rig, which is powered with three 600-hp diesel engines,[1] is drilling these wells with 5-in. drill pipe and jet rock bits in about 20 days from "spud" to "set casing." This includes wireline coring of about 1000 ft of section, which takes about 10 days. The first well drilled by the barge was a 9000-ft well near Anahuac, Texas, for The Texas Company. That well was completed in about 18 drilling days.

The big 11-ft hull of this drilling barge can be submerged to a depth

*Chief drilling engineer, Kerr-McGee Oil Industries, Inc.

[1] "GMC Quads" manufactured by General Motors Corporation.

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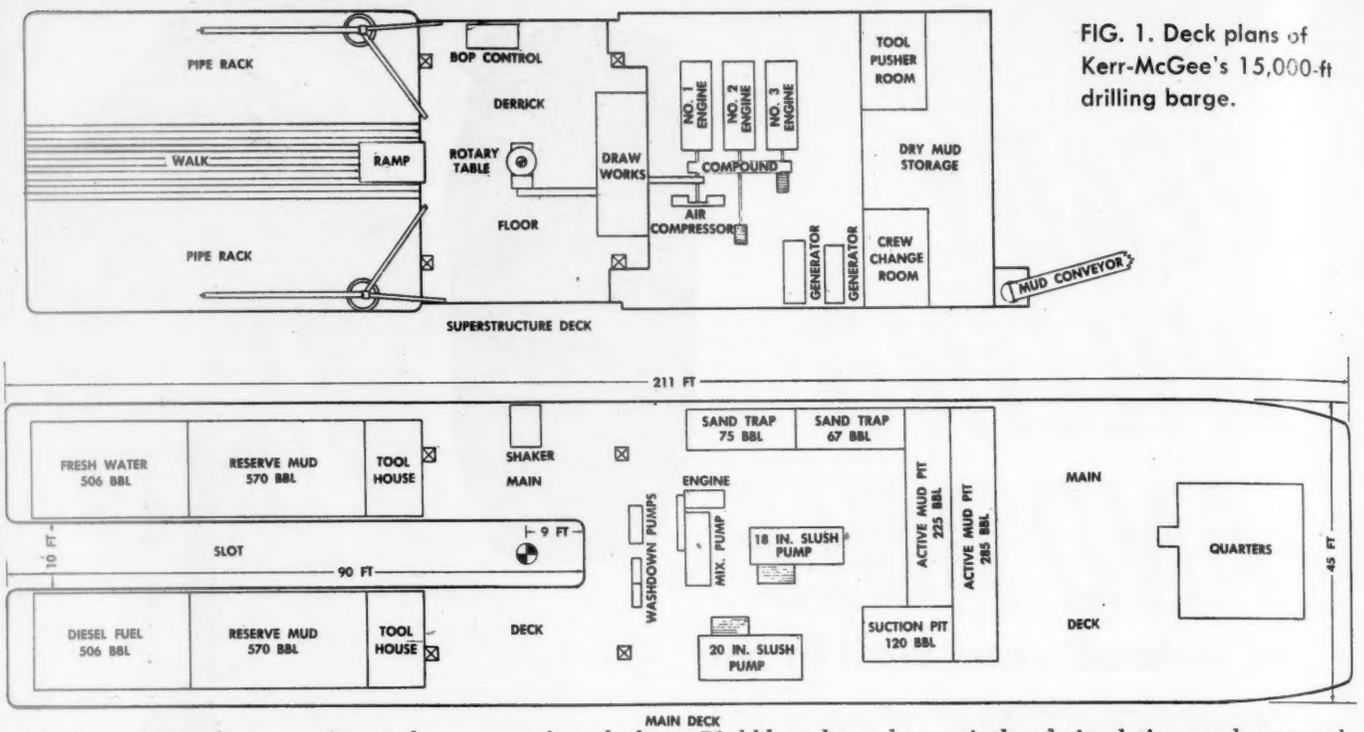

FIG. 1. Deck plans of Kerr-McGee's 15,000-ft drilling barge.

of about 11 ft, however, it can be "light-loaded" to move all of its 1400 tons through only 4½ ft of water. All the drilling equipment is mounted permanently on the barge, which is simply floated over the well site and submerged to the bottom of the bay. To move the rig, the hull is pumped out, and the barge is floated off the wellhead. Ample wellhead clearance is provided by the "slot" (see Fig. 1), which is 10 ft wide and 90 ft long.

The main deck carries four tanks and two tool houses on the slot end of the barge. Two of the tanks have a capacity of 500 bbl. One of these is used for fresh water, and the other is used for diesel fuel oil storage. The other two tanks have a capacity of 570 bbl and are used for reserve mud storage.

The shale shaker, washdown pumps, mud mixing pump, slush pumps, mud pits, sand traps, and quarters for supervisory and service personnel are also on the main deck. The shale shaker is V-belt driven from a 3-hp a-c electric motor. A centrifugal high-volume pump is used to supply rig water and is operated by a 15-hp electric motor. A 2½ by 2½-in., high-pressure, turbine-type washdown pump is operated by a 10-hp motor.

The 6 by 12-in. mud mixing pump[2] is powered by a separate 150-hp diesel engine. The slush pumps are operated by V-belt drives from the main compounding transmission on the superstructure deck. One of the slush pumps is a 600-hp, 8 by 20-in. pump[2], and the other is a 450-hp, 7¼ by 18-in. pump[2]. The two sand traps have a capacity of about 70 bbl each, and the mud pits have a total capacity of about 630 bbl.

The slush pump manifold and the mud discharge system are made of 4-in., 6000-psi test pipe and fittings. This rig has two complete mud discharge systems from slush pumps to swivel. In event of leakage or failure in piping system, a second or standby rotary hose, which is connected to the second system, may be attached to the swivel and circulation can be resumed without shutdown for repairs. The discharge piping has 4-in. lines to all mud guns, agitators, and mixers, which reduces abrasion and maintenance to a minimum. The mud circulation system is designed around operating practices used in conjunction with high-volume, high-pressure jet bit drilling.

Pipe racks have been constructed on top of the four tanks on the slot

The drilling mud from the well flows through the trough (at left) after passing through the shale shaker (not shown). Each of the two sand traps (center) is equipped with a high pressure mixing gun for stirring and agitating the mud.

[2]Manufactured by Oilwell Supply Company, Dallas, Texas.

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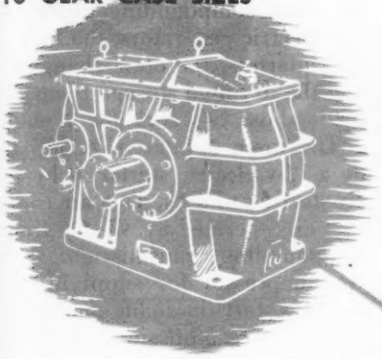

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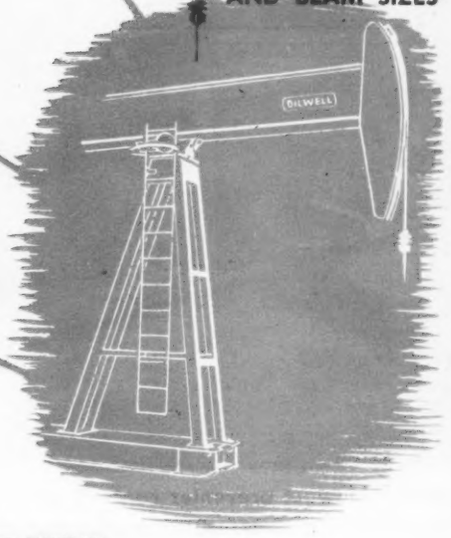
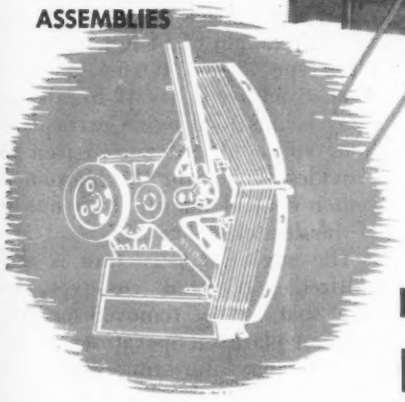


A VARIETY OF PITMAN, CRANK AND SUB-BASE ASSEMBLIES



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The chart, at right, tells the story of how combinations of 10 gear-case sizes and 9 frame-and-beam sizes plus a variety of pitman, crank and sub-base assemblies, result in a total of 44 individual units. By means of bolt-on base extensions to the larger sizes, for electric motors, multi-cylinder and single-cylinder engines, a total of 108 possible arrangements is available to meet varying power applications without costly field modifications.

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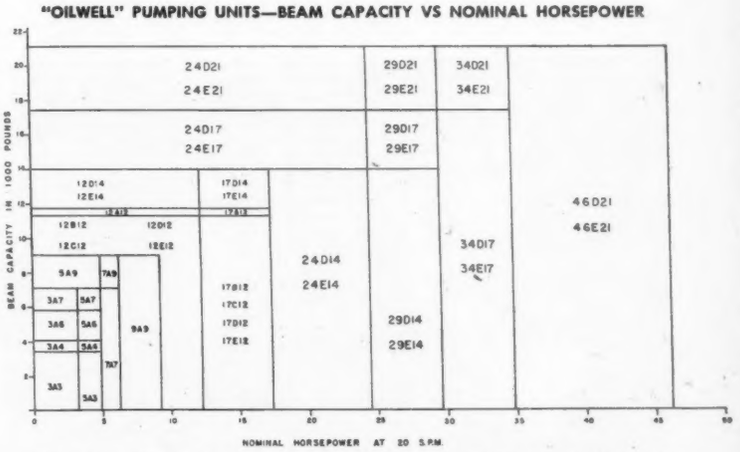

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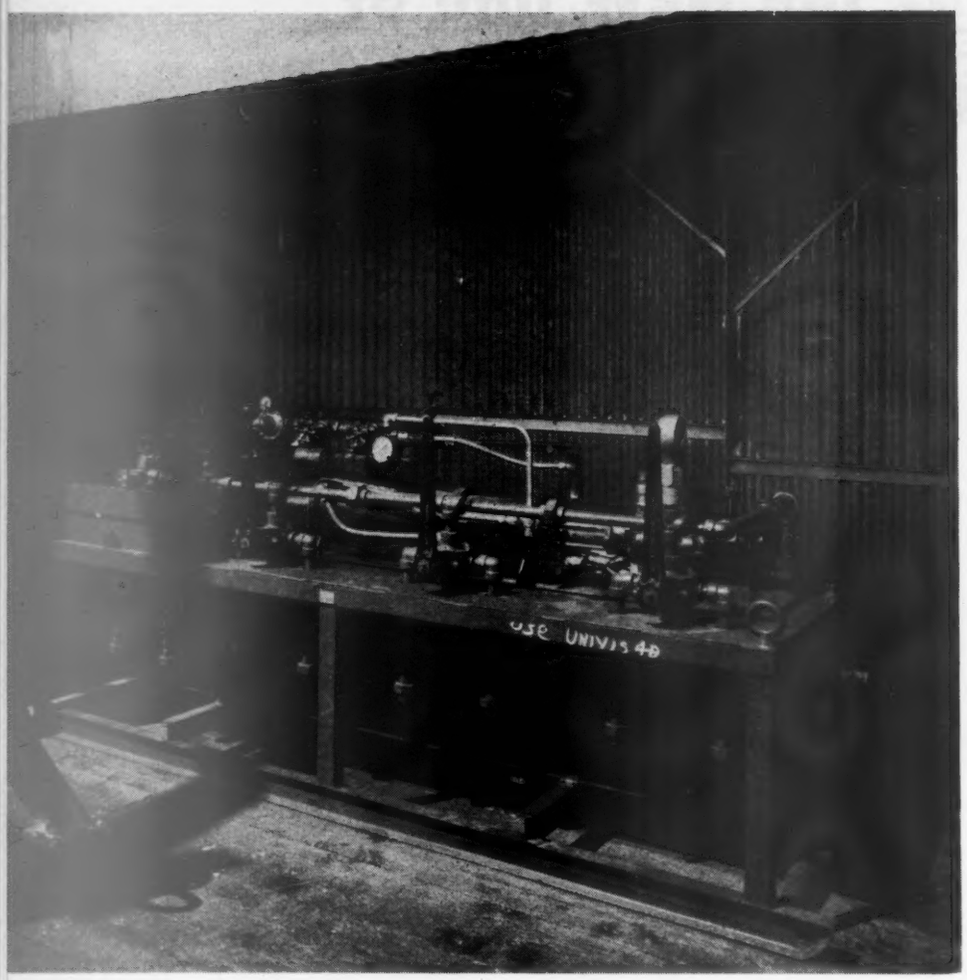


All the blowout preventer controls are unitized in this manifold at the side of the derrick floor. The blowout preventers can be closed by any one of five independent means.

end of the barge, and two electric cargo cranes have been installed to load and unload pipe and other equipment from the barge. The other end of the superstructure deck of the barge is covered completely by a galvanized sheet metal building, which provides shelter for the three main engines, the main compounding transmission, two electric generators, the tool pushers' quarters, the crew change room, and the dry mud storage room, which holds about two carloads of mud.

The main engines may be started by a 12-v electric starter or by rotary air-starting motors. Two air compressors are operated by V-belts from the compounding transmission. A third air compressor for supplying air to initially start the main engines is operated by a 5-hp single-cylinder engine. The main 60-kw electric generator and the 50-kw standby generator are operated by separate, individual engines equipped with air starters.

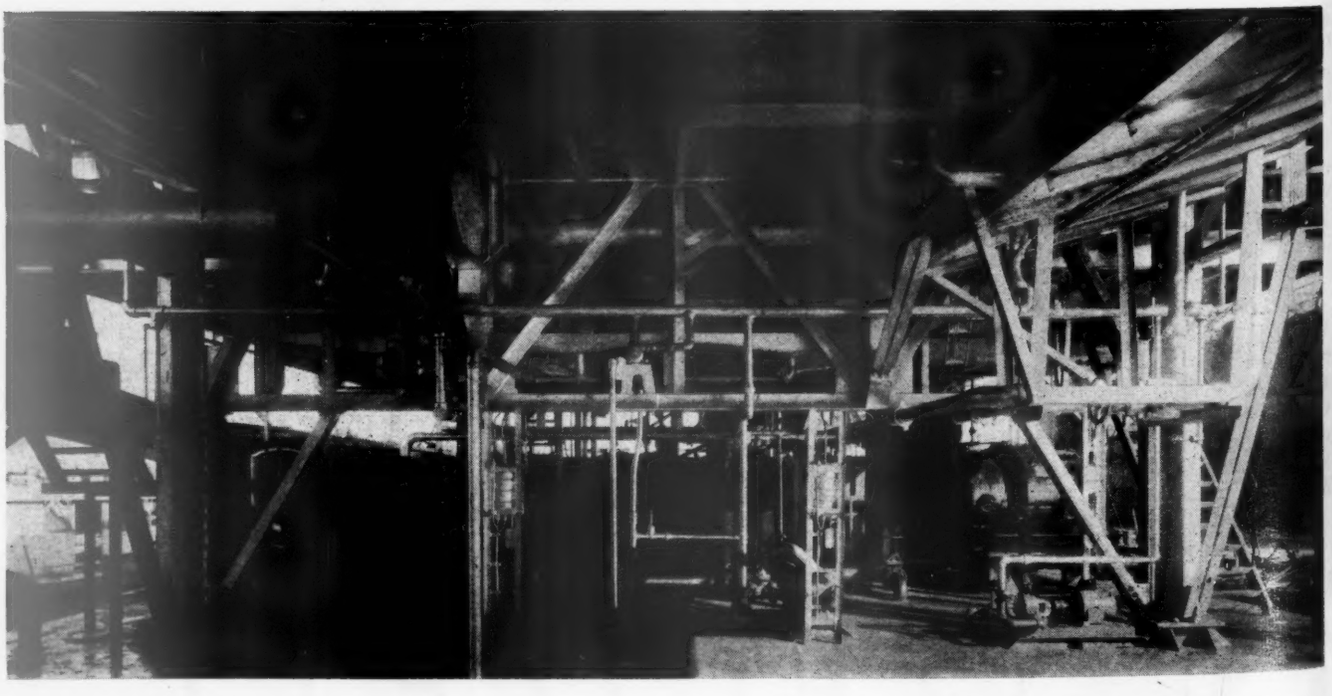
An 800,000-lb, 136-ft by 30-ft galvanized steel derrick[3] caps the derrick floor. The derrick substructure[3] has a nominal height of 14 ft 4 in., and is a truss-type, 4-post, 6-truss, galvanized steel structure. It has 42-ft galvanized floor beams to provide extra derrick floor space. A galvanized iron shed provides shelter for the blowout preventer control manifold on one side of the derrick floor.

The engine substructure is also a unitized, galvanized, truss-type, structure[3] that may be removed for use on shore or platform operations, if desirable at some future time. Galvanizing provides protection against salt air corrosion.

The drawworks[4] has a 9-in. drum

[3]Manufactured by Lee C. Moore.
[4]An Oilwell "96."

Looking toward the pump room on the main deck from the end of the slot shows the truss-type substructure that supports the derrick floor. Extra derrick floor space is provided by 42-ft galvanized floor beams that are supported by this substructure.



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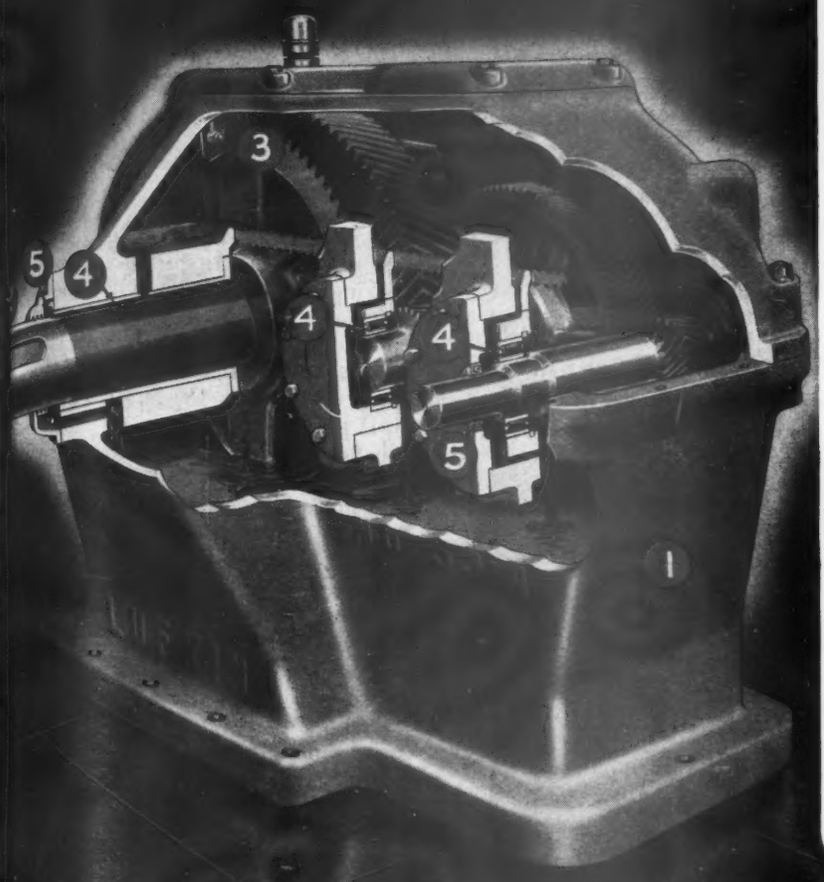

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5. The pinion shaft bearings are equipped with patented oil seals, to prevent oil leaks; while the main crankshaft is equipped with collar oil slingers and annular grooved drain covers.

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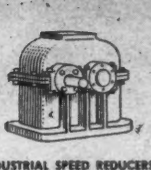
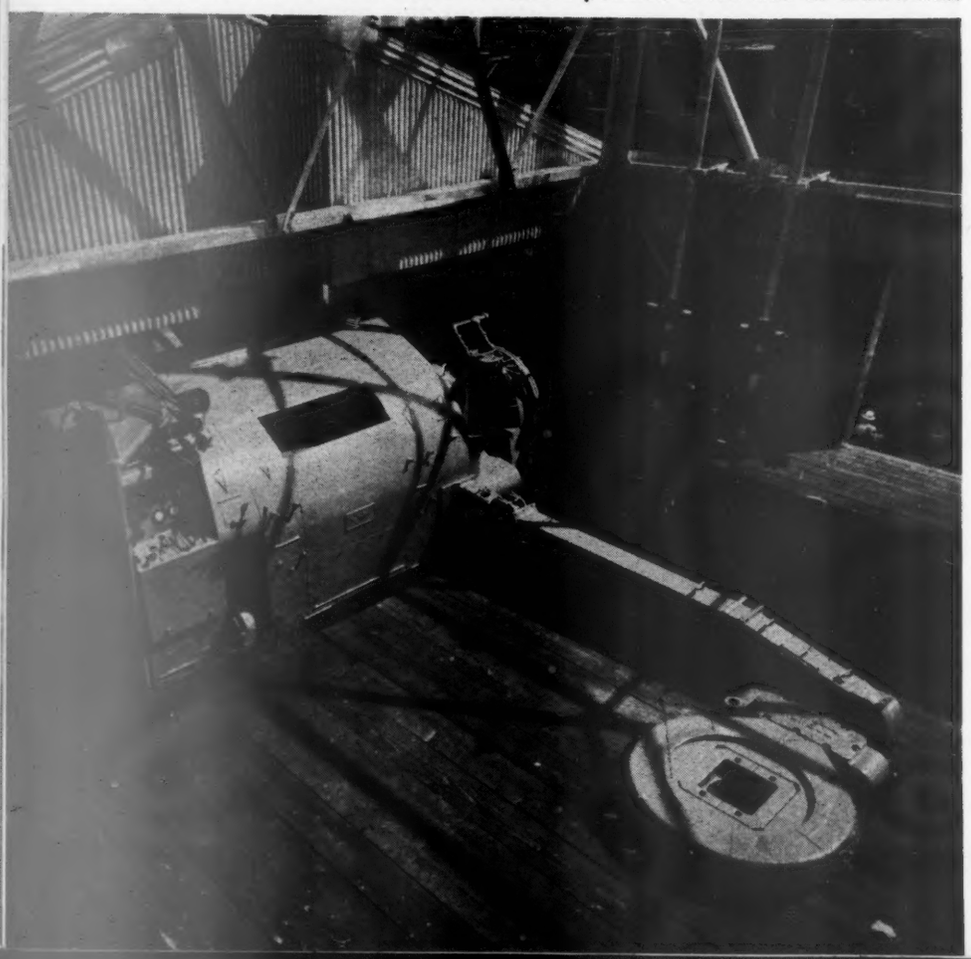

INDUSTRIAL SPEED REDUCERS AND INCREASERS

DIVISION LUFKIN FOUNDRY & MACHINE COMPANY INDUSTRIAL, MILL AND AUTOMOTIVE SUPPLIES

The 11-ft deep hull of the big drilling barge rests on the bottom in 9 ft of water at this drilling site in Corpus Christi Bay. Electric cargo cranes transfer pipe and other heavy supplies from other barges to pipe rack deck of drilling barge.

The heavy duty, 15,000-ft drawworks also drives the rotary table through a heavy chain that is enclosed in an oil-bath housing guard. Notice that all instruments and controls are centralized at driller's position at left side of drawworks.



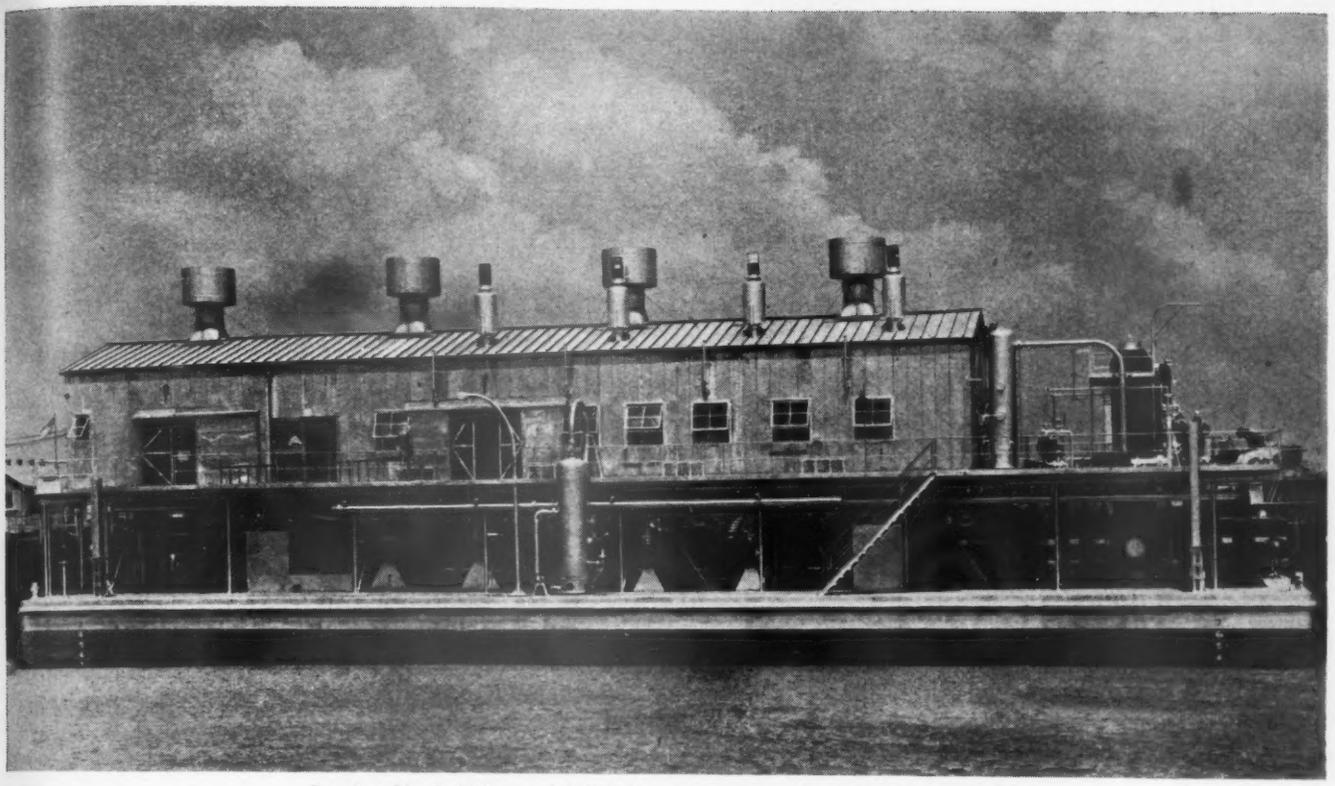
shaft and 6 hoisting speeds. The hoisting equipment of the rig is designed for stringing ten 1¼-in. wire lines, permitting a safe hook-load working capacity of about 430,000 lb. This rig has a nominal depth rating of 14,500 ft based on hoisting 4½-in. drill pipe at 90 ft per min.

Adequate blowout preventers are supplied depending upon specific conditions in the area, such as well casing programs, subsurface gas pressures, and salt water flows. Five independent means are provided for closing the modern hydraulic blowout preventers that are used on this rig: (1) air pressure from the rig, (2) high water pressure from the washdown pumps, (3) slush pump pressure, (4) hydraulic hand pump, and (5) manual controls.

The two diesel-electric generator sets provide ample a-c power for the operation of the cargo cranes, belt-type dry mud conveyor, lights, shale shaker, washdown pumps, bug blowers, refrigerators, and ventilating fans installed on the barge.

The barge is equipped with marine telephone and FM radio sets that provide constant communication facilities with shore stations and with company headquarters.

Cementing and logging equipment is transported to the rig on one of the two cargo barges assigned to service the rig. A lugger and 3 crew boats are also assigned to the service fleet. * *



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Selection and Evaluation of Wells for Hydrafrac Treatment*

JOE W. MALY[1] and TOM E. MORTON[2]

In October 1948 the Stanolind Oil and Gas Company's research department made the first public announcement of a new procedure for treating wells to revive old production or to complete for new production. In March 1949 these procedures, known as 'Hydrafrac Services', were commercially introduced to the oil industry. Since the beginning of commercial operations over 3000 fracture treatments have been produced in wells throughout the continental United States and in some foreign areas. These methods are now recognized by the oil producing industry as worthwhile means both for increasing rate of production and for the securing of greater ultimate recovery.

Hydrafrac service operations seek to increase the productivity of oil and gas wells by generating new and greater effective permeability of the producing formations in the vicinity of the bore hole. This is accomplished by hydraulically fracturing the formation with pressure in excess of that due to the over-burden. This fracturing is transmitted to the formation by high viscosity hydrocarbon gels pumped into the zone to be treated. The gel is of such viscosity that its entry into the formation at a given rate of flow can produce the pressure required in excess of that attributable to over-burden. The gel is followed down the well with a breaker agent, a chemical dissolved in oil, which within a short period of time causes the gel to revert to a low viscosity fluid. These fluids can then be run with the regular production from the well into the stock tanks and becomes a part of the first production after treatment. The gel fluid carries suspended in it into the well a quantity of graded sand. This sand, on the release of pressure necessary to fracture the formation, acts as a propping agent to hold open the fracture.

Hydrafrac service operations although now very well established, still depend for success upon correct evaluation of information available on any given well. The immense amount of practical experience now obtained through commercial operations and continued research have shown that most unsuccessful jobs can be traced to either lack of information on the well to be treated or lack of consideration of available information. It is the purpose of this paper to discuss the more possible application of Hydrafrac services. It must be recognized at the start that not all wells are applicable for processing by these methods, and that certain basic considerations must be met, otherwise success will probably not be forthcoming.

Permeability

Hydrafrac procedures have particular application in low permeability zones since a potentially greater chance exists there for creation of new effective permeability. If controlling factors are favorable, however, fractures can also be created in zones of quite high permeability.

As the only way the Hydrafrac operation can increase production is to increase the effective permeability of the bore, it is obvious that the permeability of the producing section is of great importance in selecting wells to be treated. In a well where sufficient permeability already exists to allow fluid to come into the bore at the highest possible rate that the existing bottom hole pressure will create, additional permeability will not produce a marked increase in the rate of production. Experience has indicated that a greater degree of increase in production has been obtained in formations having less than 150 millidarcies permeability than in those with more than this amount.

Reservoir Energy

The manner in which any given well or field derives its energy for production is an important factor to be considered. Although all types of production drives have responded satisfactorily to Hydrafrac operations, nevertheless consideration should be given in each instance to type of drive and the possibilities existing for success and failure in a given instance. In the case of a water drive condition careful consideration should be given to the proximity of the water-oil contact to the well bore. Where wells are actually producing water, due to an effective water drive condition, the application of Hydrafrac treatment is frequently unsuccessful. This situation should not be confused with the case wherein relatively small amounts of connate or interstitial water is produced with the oil from the well. Such wells have been successfully treated with a considerable increase in oil production and usually a proportionate increase of connate water from the formation. A well of this type represents a condition which, as far as is known, has no correction and it becomes necessary to produce the water in this instance along with the oil and treat same out on the surface.

Where energy for production must be considered as coming from gas drive, it has been found that in a reservoir wherein a high gas-oil ratio exists and wherein a gas cap exists as a reservoir characteristic Hydrafrac operations have in many cases increased gas production to greater degree than that of the oil. The condition here is quite similar to that mentioned in connection with water drives, in that the proximity of the gas-oil contact must be carefully considered, otherwise a disproportionate increase of gas to oil may result.

Results in water drive and gas cap type drives might be explained by the general assumption that the effective permeability of the water or the gas

*Presented at the spring meeting of the Mid-Continent District, API Division of Production, Herring Hotel, Amarillo, Texas, March 21-23, 1951.

[1]Division engineer, Halliburton Oil Well Cementing Company, Oklahoma City, Oklahoma.
[2]Division engineer, Halliburton Oil Well Cementing Company, Dallas, Texas.

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sections is higher than that of the oil producing section, thus allowing for easier fracturing of these zones than in the desired position, which is producing oil.

Reservoirs wherein the energy for production comes from a solution gas drive have produced some of the best results for quite obvious reasons.

Production History

The complete production history of a well to be evaluated for Hydrafrac application is important. Obviously an old depleted reservoir is not going to react with as great a production increase as a reservoir that is still early in its production life and retains most of its original energy and recoverable oil. As a broad general rule, if a well has declined slowly over a period of years, it can be assumed that the decline was due to normal withdrawal of the recoverable oil and depletion of the bottom hole pressure. Although this type of reservoir has been treated successfully in many cases the degree of success has been less than in reservoirs of opposite nature.

Consider the case of a well that was brought in with a high initial production then declined quite rapidly to a lower level which it maintained as a relatively flat decline curve over a period of time. This type of production curve can frequently be considered as caused by exhausting the regularly producible oil under the existing permeability and pressure conditions fairly close to the well bore. In such instances a radially extending fracture about the well, increasing the effective permeability of the bore, has an excellent chance for success. Wells having this type of production decline curve have, when treated, shown very high increases in production that have thereafter been maintained at a quite satisfactory rate.

The question of completely exhausted wells always brings up argument. When working from core analyses giving the amount of oil in place, producible oil and the amount that can be produced by primary methods, it has been found that quite often more or less oil has been recovered than is shown by original calculations. This does not attempt to say that core analyses are not important; however, it must be admitted that frequently discrepancies are bound to exist. The entire subject of depleted wells resolves itself into a matter of how can we correctly state when a zone is actually depleted to the point of subeconomic production?

It is obvious that the subject of well history from a production standpoint can be correlated with the type of drive existing in the reservoir. The history of the water production from a well gives a good insight into the type of reservoir which is present and aids in determining whether the water produced is connate or water drive condition. For example, wells that make a small amount of water each day over a period of time in proportion to the total fluid produced, may usually be assumed to be producing connate water. In many instances this volume of water decreases with the life of the well in direct accordance with the decrease in total fluid produced. On the other hand, in wells where the water production curve climbs in relation to the amount of oil produced it may be assumed that there is a wa-

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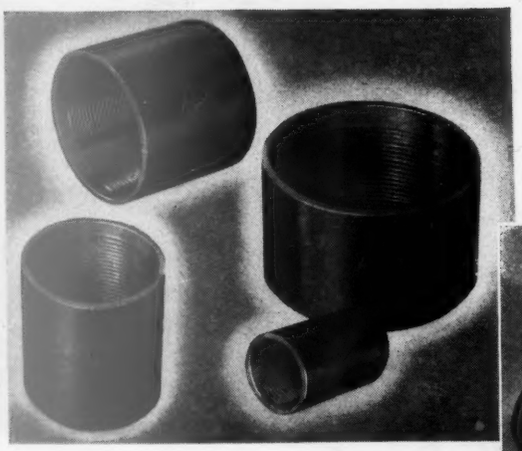

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ter drive present or possibly a leak around the shoe or in the casing itself. Frequently water analyses in these instances will indicate whether the water comes from the producing formation or from other source. These factors should be carefully considered prior to treatment of the well as fracturing treatment success may be affected by the nature and source of this water. The same statements in like maner apply to increasing or decreasing gas in any given instance.

Work-Over History

The work-over history of a well should be considered as a part of any evaluation for possible Hydrafrac treatment. Although work-over operations are recognized as important, much previous thought on the subject can be minimized by reason of actual experience. It was believed originally that a well that had been shot with nitroglycerin might not respond as well as one that had not been shot before the application of Hydrafrac treatment. Experience has taught that this is somewhat true; however, a great many wells considered to be depleted from a shooting and acidizing standpoint have been helped considerably by hydraulic fracturing methods.

In some wells where isolation of a pay sand from a shale section was impossible, the sand has actually been shot with small charges prior to Hydrafrac operation in order to create small fractures which could be then extended hydraulically without breaking into the shale zone. A number of such cases have been successfully treated which resulted in good production.

Prior acid treatment should be considered carefully in lime or sandy lime wells. In some cases results of Hydrafrac treatments in wells after acidizing have not been as successful as treatment in wells that have not been acidized. On the other hand, there are wells that were acidized prior to a Hydrafrac treatment, the treatment resulting in excellent success. In many limestone wells wherein the nature of the formation is such that it is not rapidly or highly acid soluble the application of what is known as a Hydrafrac-Acid Combination method has been of considerable benefit. In such procedures, the limestone is fractured around the bore of the well with the hydrocarbon gel immediately followed by an ordinary acid treating procedure, the thought being that the acid can follow away from the well bore along the lines of the fracture produced and result in greater areas for reaction with the acid.

Possibly the greatest value in consideration of prior work-overs lies in the idea that it is easier to obtain a reasonable assumption from such well history as to the state of depletion of the well and to the mechanical characteristics of the well bore and well equipment. All of these affect the possibility for success or even for application of hydraulic fracturing applications.

Physical Formation Characteristics

The thickness of the formation to be treated is of paramount importance. It has been found that long sections are usually more difficult to treat than shorter ones. This is due to the fact that the combinations of formation thickness and permeability are the prime factors in the rate of injection necessary at any given viscosity to produce hydraulic fracturing pressures.

In many areas where pay zones are of great thickness it has been found possible to segregate short sections of the formation to treat them individually and produce multiple fractures within the zone. This may be accomplished in either of two ways: (1) By setting pipe through the completed zone and perforating at intervals along the pay zone, and (2) by carefully drilling the producing section after setting casing to render the bore of

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the hole smaller than the ID of the casing and using multiple isolation types of packers. In the latter case it is highly important that the drilling be carefully conducted. Diamond cored holes usually produce the best results though other methods have been quite successful. This is true, provided care is used to produce a clean and straight bore. In any given area where the open hole completion system is to be used and multiple packers employed for isolation, it is quite important that a caliper log be made of at least the first well in the area to be treated. From such a log it is possible to pick good points of application for the setting of the packers.

Where casing is set to be perforated across short intervals, great care should be used to obtain the very best possible cementing job in order to produce a seal between groups of perforations so that flow from one set of perforations will not come back outside the pipe and into another. Likewise, it is necessary that the perforations be carefully placed to avoid either upper or lower, or intermediate, shale sand contacts. Possibly the best rule is to perform the perforating job with great care and not try to take in the entire sand section in the belief that some perforations into the shale will not hurt later production of the well since the shale, as a rule, does not carry anything producible. These exposed shale bodies do have an effect on hydraulic fracturing operations and should be wherever possible avoided.

Shale breaks within the producing zone should be considered under the theory that laminated shale will probably fracture easier than an adjoining sand section. Originally it was thought that if any shale at all was exposed to the treatment, then the relative possibility for success of the treatment was reduced. Here again experience has shown that this is not always true. The type of shale must be considered before condemning the possible results of a proposed treatment. Hard consolidated sections of shale do not necessarily affect the results. Likewise, in a sand where small lenses, usually of thin nature, are exposed they can be generally ignored. It is now thought that a fracture adjacent to the shale body, provided that the shale is of the hard type, will probably go along the shale-sand bedding plane thereby increasing the effective permeability of the bore but perhaps not as much as though the fracture had been completely within the sand body. On the other hand, where rotten or soft shales are present, they should, wherever possible, be isolated from contact with the hydraulic fracturing fluids.

Sands commonly known as dirty or trashy usually have low permeability and successful results have been obtained in such instances. It is also known to be true that certain sands, usually of the dirty or trashy types, do not always respond well to shooting with nitroglycerin. In many instances of this kind such comparatively soft sands have reacted very favorably to the Hydrafrac processes.

The bottom hole pressure existing in the zone should be considered; however, there can be no iron-clad rule laid down for the amount of bottom hole pressure necessary for successful Hydrafrac treatment results. There should, of course, be enough pressure to bring oil into the well bore. While it was at one time thought that a high bottom hole pressure, comparatively speaking, was an absolute necessity, again experience has shown that many wells may be treated successfully where extremely low bottom hole pressures exist. This is a true case, in general, of the Eastern oil producing regions of the United States where many successful results have been obtained. A good rule of thumb for consideration in these instances is that if a well can be statically shut-in for two or three days and

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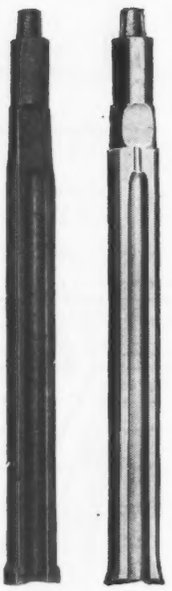

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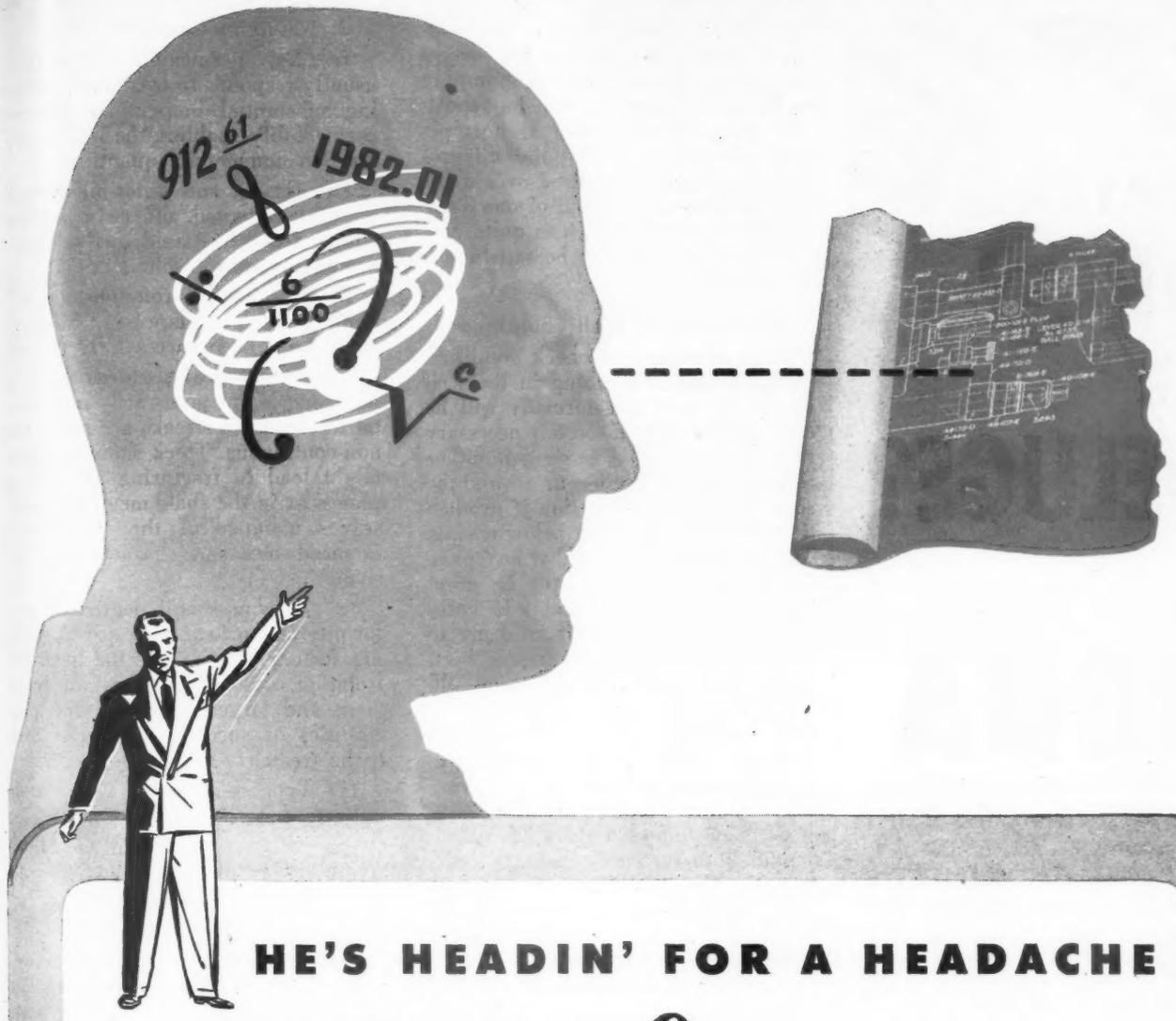

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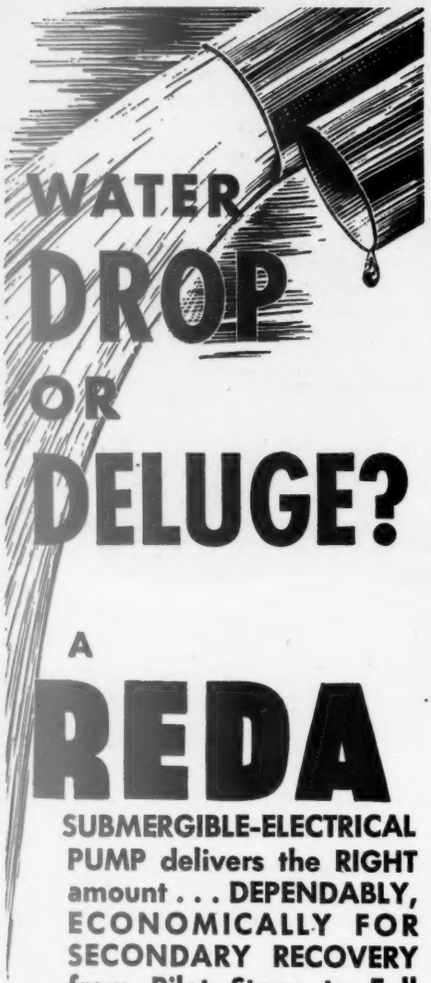

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then recover production of the shut-down period, the chances for success are good. In the case of pumping wells, even those that can be repeatedly pumped off within a short period of time, if static build up produces a rise in fluid level over a period of time beyond that of one days' pumping period, then it is quite possible that the well can be satisfactorily treated.

Conditions of Well Equipment

It is necessary to check condition of the casing and tubing in the well since high pressure normally will be encountered. It is absolutely necessary that the casing be cemented, either through the pay section or around the shoe above the pay section if production is from open hole below casing. Tubing should be such that any pressures obtained will not be great enough to burst the string. In cases where larger volumes of fluid are to be used for treatment, it has been found that lower pressures are obtained by using larger size tubing or drill pipe that aid in reduction of frictional losses. It is generally preferable to have at least 2½ in. tubing as a working string rather than 2 in. or smaller, though results have been had in both instances that are satisfactory. The condition of the well head, or blow-out preventer, should be checked as it is usually desirable to maintain some pressure on the annulus about the working string during the course of treatment. This pressure is applied to minimize the possibility of casing collapse in the event of fluid loss up behind the shoe or above perforations to a point above the packer setting. Wherever possible the annulus should be filled with oil though in many cases it has been necessary to use mud or water to effectively hold back pressure in the reservoir.

Listed as follows in an outline manner are a number of factors and subfactors to be individually considered in the selection of any given well for a Hydrafrac service operation:

1. Ability to isolate the pay zone to be treated from shale sections in order to prevent fracturing in and along sand shale interfaces.

(a) A good cement job is essential.

(b) Open hole wells will generally present more unsuitable conditions for treatment than where casing is set through pay zone..

(c) Open hole packers may be used in some wells where hole and formation conditions are satisfactory for packer seat.

(d) Selective perforating to eliminate shale zones is desired.

2. Nature of formation.

(a) Low permeability formation usually responds to treatment, obtaining substantial increase in effective permeability enabling the well to produce in commercial quantities.

(b) Gas-oil and water-oil contacts must be observed, otherwise adverse effects from increased gas or water production may result.

(c) Fractured formations are difficult to isolate; however, complete zones have been successfully treated.

(d) Presence of shale stringers in pay zone is not necessarily detrimental to success if streaks are small and non-continuous. Thick shale stringers might lead to fracturing at bedding planes or in the shale members themselves because of the rather pronounced cleavage characteristics of shale.

(e) Thickness and degree of uniformity of the formation are controlling factors determining the need for isolation of separate zones for treatment and largely influence the possibilities of success within the zone to be treated.

(f) Type of drive in reservoir is important.

(g) Effect of treatment on future secondary recovery should be considered.

3. State of depletion.

(a) There must be sufficient recoverable oil in place and reservoir pressure in the formation so that increased recovery rate can be realized if effective permeability of the formation is increased.

(b) Pressure build-up during shut in period should be favorable.

(c) Oil flush after shut down for several days will indicate bottom hole pressure.

(d) On new wells, rate of closed in pressure build-up on drill stem testing charts offers a good means of evaluation.

(e) Production decline curves should be available.

4. Previous work-overs.

The type and degree of previous work-overs may limit the effectiveness of a Hydrafrac treatment. If a formation has been repeatedly worked over, killed, squeezed, acidized, shot, etc., fractures may have already been created and further fracturing may not result in additional productivity, especially if the created fracture was caused in an undesirable place.

5. Mechanical well conditions.

(a) Well-head, casing, packers, and tubing strings should be able to withstand treating pressures.

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(b) Method and amount of cement should be evaluated to insure a satisfactory cement job covering the zones to be treated.

In addition to all the foregoing basic factors and general rules, individual problems occur on each and every well considered for Hydrafrac treatment; however, all information concerning the well in question and information on adjoining wells should be made available for study before a final decision for treatment is made. It can be stated that results in the experience of application of Hydrafrac treatments compare quite favorably to the degree of fulfillment of the above basic factors outlined in the selection of a well for such treatment. It is admitted that there have been numerous cases wherein all of these factors were not fulfilled and yet successful treatments resulted. This, however, ties back to the individual problems of each well and each area being considered, and the fact that wells vary widely. All factors can perhaps never be so fully evaluated that 100 per cent success or failure can be predicted and it is not expected that such will ever be the case. The fact, however, that successful results are being obtained in about 75 per cent of all treatments applied gives a high degree of assurance that if the information available for consideration is studied a reasonably high expectation of success can be realized. It is acknowledged that Hydrafrac operations are not going to increase production under any and all conditions. It is to be repeated that all informative records of the well, including electric logs, production history, core analyses, drill stem tests, and the drilling log, if possible, should be carefully and thoroughly studied.

The commercial recommendations for use of the Hydrafrac procedures have been handled very cautionsly and it is believed that this caution has aided the industry by the outstanding results that have been obtained in the now more than 3000 fractures produced. As previously mentioned, emphasis on certain original points of consideration has changed due to the practical experience gained during the two years of commercial operations. Continued research and observation will probably lead to further modification as more and more areas of application are discovered.

Acknowledgment

The authors extend their appreciation to the management of Halliburton Oil Well Cementing Company for allowing them the time necessary to prepare and present this paper.

* * *

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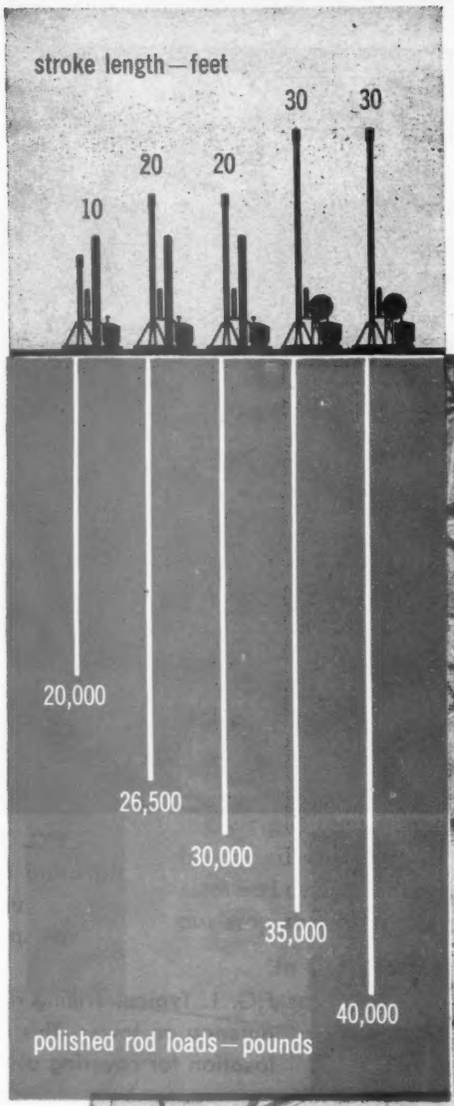

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FIG. 2. L. H. Moore in dog house at drilling rig using two-way radio. Fleetfone mobile radio unit mounts directly on wall. Re-entrant type speaker is used to overcome engine noise.

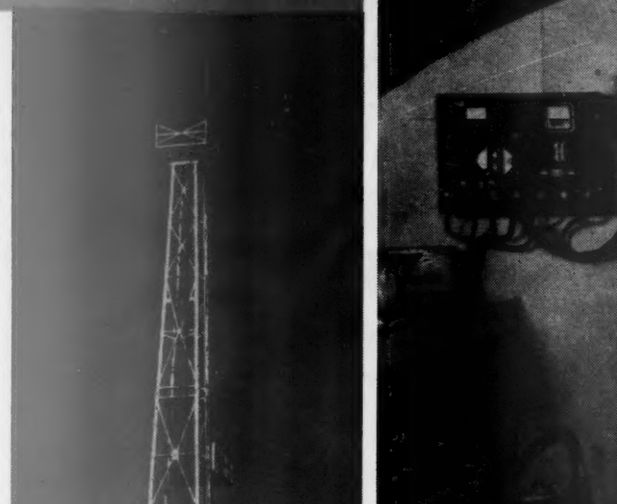

FIG. 1. Typical drilling rig with two-way radio antenna on tower. This makes a natural and ideal location for covering distances up to 120 miles.

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PAUL A. GREENMEYER[1]

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[2]Fleetfone units manufactured by RCA.

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● Next, a series of heat-treating operations performed over the *entire length* of the Kelly in one operation, develop the metallurgical properties of the steel to provide the *best balance* of shock-resisting toughness and wear-resisting hardness.

● Additional heat-treatments harden the threaded ends for maximum life and service.

● All residual forging stresses are relieved by these heat-treating processes, thus eliminating the most prevalent cause of bending and deformation.

● The Kellys are then carefully bored by precision drilling machines so that the bore is precisely centered end-to-end, then double-checked by highly-accurate survey devices. For products with bores 2¼" diameter or larger, wall thickness of the Kelly *must not* vary more than *one-sixteenth* inch for each 10 ft. of product length, or fraction thereof.

● The Kelly itself is also accurately surveyed for straightness and *must* be straight within *one-eighth* inch when measured at *any* point over its entire length.

● The alignment of the projected axis of each threaded end, when checked with the precise Baash-Ross Alignoscope, *must* be within *one-eighth* inch of the longitudinal axis of the Kelly for each 10 ft. of Kelly length, or fraction thereof.

● In addition, threads *must* pass, not only all API specifications, but also unusually rigid Baash-Ross specifications on thread form, taper, lead, finish, etc.

The above highlight only a few of the many controls maintained by Baash-Ross to insure absolute straightness, long-life and maximum all-around performance from every Baash-Ross Kelly!

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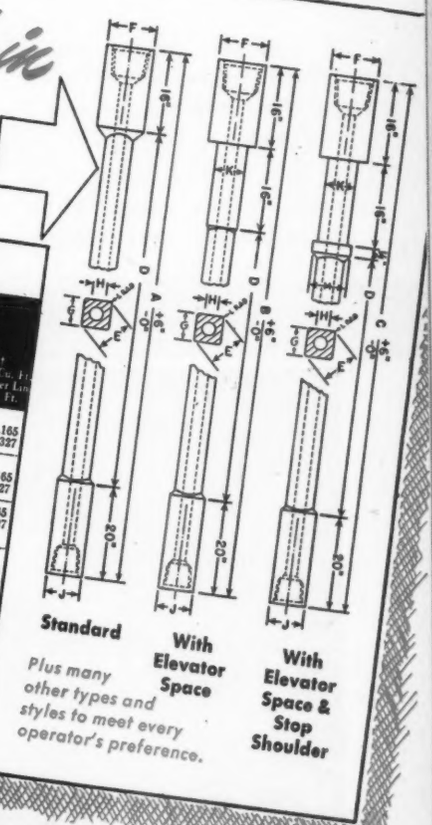
3	35 30 54	36–4 39–4 41–4	36–6 39–6 41–6	32 27 51	4½ Reg. 6⅝ Reg.	6⅛* 7⅛	2⅝ Reg. 2⅞ I.F.	3¾ 4⅛	1½ 1⅝	3	2	2	⅝	4¼	*.165 .327
3½	35 30 54	36–4 39–4 41–4	36–6 39–6 41–6	32 27 51	4½ Reg. 6⅝ Reg.	6⅛* 7⅛	3½ Reg. 3½ I.F.	4⅛ 4⅜	2 2⅛	3	2	2	⅝	4¾	*.165 .327
4	35 30 54	36–4 39–4 55–4	36–6 39–6 55–6	32 27 51	4½ Reg. 6⅝ Reg.	6⅛* 7⅛	4½ Reg. 4½ I.F.	4⅝ 4⅞	2½ 2⅝	4	3	3	½	4¾	*.165 .327
5	30 30 54	39–4 41–4 55–4	39–6 41–6 55–6	27 27 51	6⅝ Reg.	7⅛	5½ Reg. 5½ I.F.	6⅝ 7⅛	3½ 3¾	5	4	4	½	5¾	*.165 .327
6	30 30 54	39–4 41–4 55–4	39–6 41–6 55–6	27 27 51	6⅝ Reg.	7⅛	6⅝ Reg. 6⅝ I.F.	7⅜ 7⅝	3½ 3½	6	5	5	½	7	.327
										7⅛	6	6¾	⅝	8	.327

Sizes shown in RED are A.P.I. standard.
* Alternate 5⅝ inches O.D.—.180 cu. ft. per lineal ft
† Volume based on largest diameter of kelly



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times. Previously, either a driller or a pusher would try to make a daily report. In some cases, more than a day would go by without a report.

"From the drilling contractor's point of view," said Lamar H. Moore, president of the company, "it cuts down on the work of making rounds to find out what's happening. Whether in my home, my car, or in my office, I always know where I stand. That gives peace of mind. Things can happen fast, out at the drilling rigs. Each well represents a big risk — you can lose a hole at any time. The whole operation is under better control, however, now that we use radio."

Here's a typical conversation between the contractor in his car and the drilling rig:

"Car 1, calling Rig 1."

"This is Rig 1."

"How did you make out today?"

"Pretty slow because it took two loads of mud to fill the hole—vacuum sucked in two whole loads."

"How deep are you?"

"About 1420 or 25 . . . let me see . . . exactly 1423."

With accurate data like the foregoing available at a moment's notice, it is understandable that operators want their drilling contractors to use two-way radio in their operations.

Rhodes Radio System

Because of his extremely successful use of radio, Moore recommended it to a fellow drilling contractor, Rhodes. The Rhodes radio system has been in operation nearly a year and is repeating the efficient performance of the Moore system. The Rhodes radio system consists of four base systems: a 250-watt set[2] at Abilene and three 50-watt stations[3]. The 250-watt main station has four remote controls: One at the office, one in Rhodes' home, one in a tool pusher's home, and one in a drilling superintendent's home. The four portable stations are moved about West Texas by the drilling superintendents. They set them up in the hotels where they are staying. Twelve cars are equipped with 60-watt mobile radios. Six drilling rigs are also equipped with 60-watt mobile units. Every man and all rigs are thus in constant communication with the office and with each other.

"I save $850 monthly on 'phone bills alone," said Rhodes, "as a result of using radio. Before, we made two or three phone calls per day per rig. Our biggest saving is in time on rigs—there is no more delay in getting in touch with the rig. I save time, too, by having my office do things for

[3]Link.

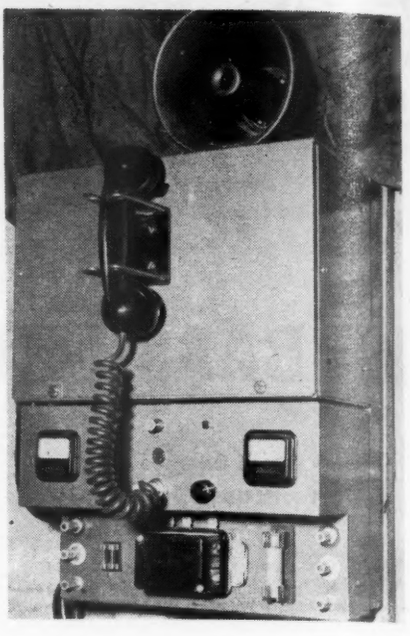

FIG. 3. The entire two-way radio set is mounted compactly on the wall of a dog house at the drilling rig. The lower unit contains the controls, meters, and voltage regulator, which controls a standard automobile generator mounted on the drawworks.

FIG. 4. Below is installation of Fleetfone mobile radio transmitter-receiver in trunk of car. It takes space ordinarily not used and leaves room for tools and supplies.

FIG. 5. H. C. Wilson, general superintendent, Geochemical Surveys, is enthusiastic user of two-way radio. Controls are shown attached to dash of car under front panel. Only two knobs are employed: One to control volume, the other to control noise.

FIG. 6. Ray Moore, general manager Moore & Moore Drilling Company, at company office in Abilene says, "I can shift equipment where it's needed most. For example when one rig blew a rotary hose, I called another rig several miles away that was not working and had them send their rotary hose over. Since the rigs were about 55 miles from the shop, radio saved several hours. It costs about $50 per hour to shut down. Such things happen all the time."

FIG. 7. L. H. Moore, president, Moutray-Moore Drilling Company, at remote control station in his home. He has a radio right beside his bed so that he always knows what's going on. Furthermore, Mrs. Moore always knows where he is and whether he is coming home for dinner.

me—like making outside phone calls —while I am out on the road. Radio also saves a lot of miles on cars."

Type of Radio System

Both these radio systems are of the simplex or single-frequency type. This means that all units in the system hear what is going on, and all can talk to one another. There is provision for the following communication:

1. Car to car.
2. Car to station.
3. Station to car.
4. Station to rig.
5. Rig to rig.

Thus, everyone knows exactly what is going on everywhere at all times.

Although conversations may be monitored and scouted by competitors, there is nothing that prevents the contractor from devising his own secret code when talking about "tight" holes. It is common practice in the safety and transportation radio system to use code abbreviations in order to save time. A taxicab company, for example, uses the words, "Signal One" to mean "I am passing from Zone 1 to Zone 2." The telephone people use D. A. to signify "doesn't answer." Similarly, a drilling contractor can make up his own private list of code signals, so as to prevent confidential information from leaking out.

The men at the rig like radio, because it relieves them of a lot of responsibility. Before, they had either to take a chance and make a decision themselves or wait until word came from the boss. Now, they are always in touch with the boss and can get a decision whenever needed. Blunders and delays may be prevented.

When a tool pusher or drilling superintendent is on the road, he is in constant communication with both the office and the rigs. He likes radio, because he does not have to stay near a phone — stations and cars can always reach him no matter where he drives. In addition, he does not do a lot of aimless driving, but goes where he is needed. As a result, efficiency is increased.

West Central Texas is fairly flat country. This makes radio communication practical over long distances. With the systems described, 50-mile conversations between station and cars is commonplace. Car-to-car range is about 20 miles. From rigs to base stations, distances up to 90 miles are being covered under favorable conditions and terrain.

How to Get a Radio System

In order to obtain a construction permit for a radio system from the Federal Communications Commission, it is necessary to contact the nearest regional Frequency Allocation Committee. As the FCC is faced with many problems in assigning the available frequency channels, it has encouraged the organization of these advisory committees. They are composed of representatives from various industries and radio services, who serve without pay for benefit of their mutual interests.

The national committee is subdivided according to industry and region. The Gulf States Committee, for example, takes care of the following five states: Texas, Mississippi, Louisiana, Arkansas, and Florida. Either a representative from one of the major manufacturers of two-way radio equipment, or a local mobile radio specialist can usually be of assistance in making contact with the committee. After the application has been considered, the coordinator from the committee makes a recommendation to the FCC.

To determine whether it is practical to use radio for a given application, the commercial representatives of major manufacturers are usually available in the larger cities. As a courtesy to prospective users, these commercial engineers give general advice as well as recommend a system.

In some towns, of which Abilene is a particular example, there is also a local organization that specializes in mobile radio communications, but it does not sell equipment. Through qualified local mobile radio consultants or engineers the best type of equipment for a particular system may be selected.

"I was fortunate" said Moore, "in obtaining the services of an Abilene radio engineer, Herschel Peake, to design my system for me. He made tests of different types of equipment and helped me select equipment that would combine long range with dependable operation. Price was not the deciding factor. We are well satisfied with results. Our radio has cut down on the

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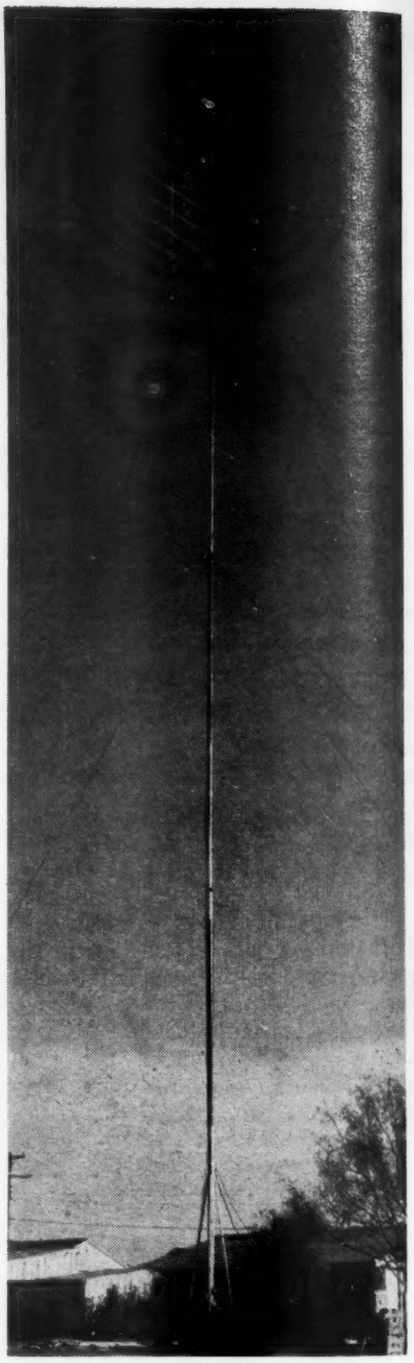

FIG. 8. 150-ft antenna for 250-watt main station in Rhodes radio system. (Note typical TV receiving antenna hung on the mast to bring in programs from Fort Worth and Dallas.)

work of making rounds and increased our efficiency. It is always dependable."

Two-way radio has seen a remarkable rise since the end of the war in 1945, and, as is often the case, the smaller business man has been foremost in taking advantage of its benefits.

"I don't see how we ever did business without it," is the way Moore sums it up, "and now we certainly can't do business without it." * * *

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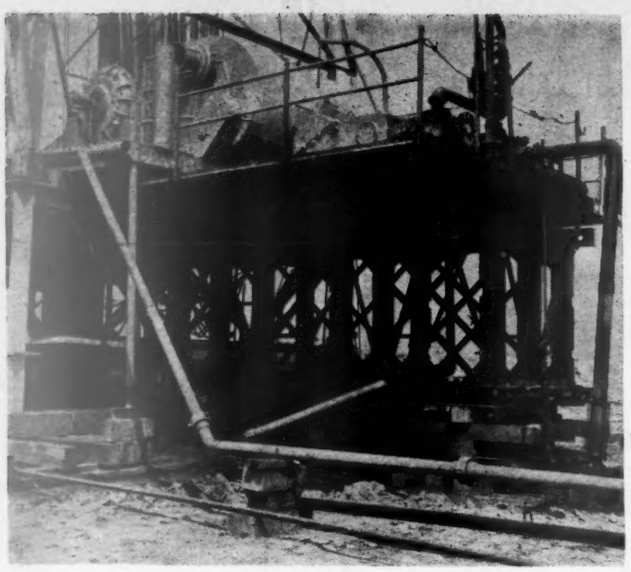

FIG. 1. The section of mud line in the foreground between the two hammer-type unions is reversed to accommodate the changes in height and floor area when a 14-ft substructure replaces the 10-ft unit shown and the floor size is changed from 24 to 30 ft.

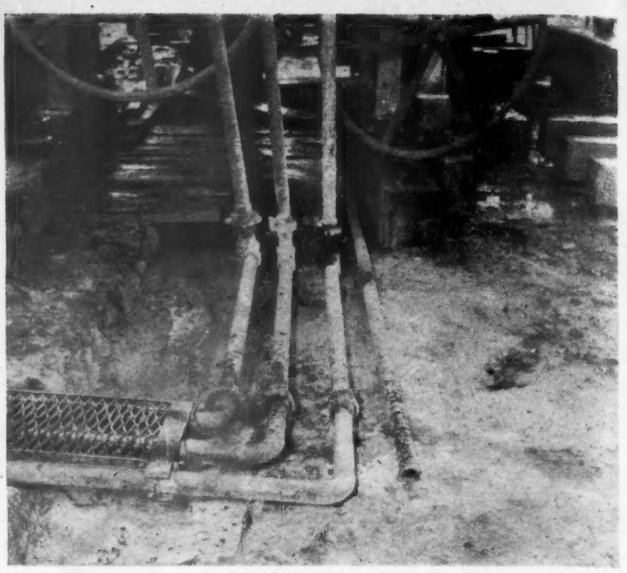

FIG. 2. A difference of 4 ft in length of horizontal and vertical sections of the connecting units between unions on these three blowout preventer control lines allows them to be used as shown on a 24-ft derrick floor, or reversed for a rig with a 30-ft floor.

Reversible Connections for Rig Shifts

Lines from the ground to derrick floor can be connected rapidly when moving from a 10-ft to a 14-ft substructure, or vice versa

ELTON STERRETT

MOVING a rig from a 10-ft to a 14-ft substructure also means that the derrick floor will change from a 24-ft square to a 30-ft square. This would usually require that all piping to the derrick floor, such as mud lines, water and blowout preventer connections, and steam lines (if a steam rig) would have to be refitted to tie in the services.

The Housh Drilling Company of Houston, however, utilizes accurately proportion reversible tie-in units, equipped with identical unions at both ends, so that when used one way, the connectors will give proper spacing and lift to fit the 10-ft substructure and the 24-ft floor, and when reversed, the connectors will take up 4 ft of additional height to allow the mains to lie on the ground, and will be shortened by the 3 ft absorbed by the wider derrick floor.

On the mud line, Fig. 1, the hookup is for the 10-ft substructure, with the long leg of the pipe in the foreground serving as a horizontal extension to the mud main. The short end beyond the 45-deg bend contributes to the rise to derrick floor. If a 14-ft substructure is to be used, the ends of the tie-in are reversed, with the short section made onto the union at the right, with the longer section extending upward at a 45-deg angle to meet the higher position of the union on the slanting section of the line.

The blowout preventer service lines shown in Fig. 2 operate in the same manner. The long portion of the connector carries the elbows inward far enough to bring the risers vertically under the blowout preventer controls. On a 30-ft floor the blowout preventer control is 3 ft farther from the center, and the three tie-ins are set with the short end tied to the panel of three lines, and the other ends extend upward for 4 ft to contact the lower ends of the standardized piping from the control.

The steam line shown at the extreme right of Fig. 1, is also reversible. The ell at ground level is fitted with a long and a short leg, so proportioned that when set as shown, it will extend the line horizontally and meet the drop line from the engine on a 10-ft substructure, or may be reversed as the 30-ft floor extends the engine platform 3 ft nearer to the main steam distribution line.

The engineered connections described are made without cutting, welding, or exchange of units. These 2-way connectors allow the distance from well center line to boilers to be kept at 150 ft, regardless of the derrick floor size, and permit one standard to be followed for all rigging-up operations. ★ ★ ★

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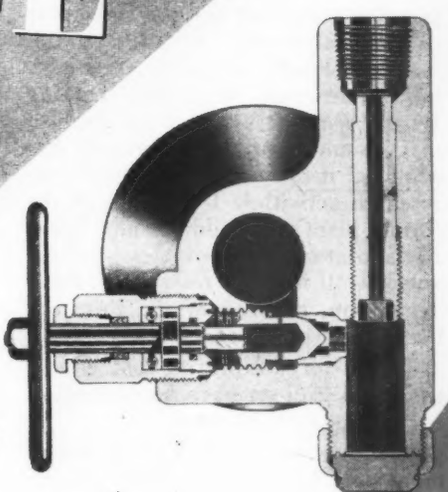

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U. of T. Research Center

Six of 17 laboratories in plant nine miles from Austin, Texas, are devoted to oil industry problems

FRED D. THOMPSON

AN expanding program of research of direct benefit to the petroleum industry is detailed in the semi-annual report, just released, of The Off-Campus Research Center of the University of Texas at Austin.

The Research Center is situated 9 miles northwest of Austin. During World War II it was a government magnesium plant. The university has acquired it to facilitate its increasing research activities. Twenty-six of the former plant's 34 buildings now house 17 laboratories. Six of them are devoted to oil industry research, J. Neils Thompson, director of the Research Center, reports.

Thompson maintains that educational institutions have an obligation to conduct such research.

"In a state which has produced more than 17½ billion dollars worth of oil in little more than a half century," he writes, "the educational system would be negligent indeed if it did not contribute heavily in both applied and basic research to the petroleum industry."

"Problems are encountered frequently in modern oil industry techniques and processes which only research can solve," he continues. "To assist the industry in the solution of its problems is one of the major goals of University of Texas research."

Each of the six laboratories cited is an integral part of some University department or bureau. Three of them —the Well Sample and Core Library, the U. S. Geological Survey Laboratory and the Mineral Technology Laboratory—are under the executive supervision of Dr. John T. Lonsdale, head of the University's Bureau of Economic Geology.

Activities of the six laboratories are described as follows:

1. **The Well Sample and Core Library** of The Bureau of Economic Geology is one of the largest public collections of its kind in the United States. It contains 3,000,000 individual samples representing 32,000 oil, gas and water wells in every section of the State. The collection weighs 300 tons and, in length of geologic sections represented, measures approximately 15,000 miles. The library also has a substantial collection of oil well cores. From 150 to 200 oil company geologists make use of the collections in their investigations annually. The well samples are conveniently filed, material is easily located, and visiting geologists and students have the privilege of subjecting the samples to any process of analysis desired. The library is designed to promote a greater knowledge of the geology of Texas by bringing together an extensive range of material. More specifically, it offers a permanent file of subsurface samples which can be worked and reworked as new discoveries are made and new techniques developed.

2. **The U. S. Geological Survey Laboratory** is investigating geological conditions in the limestone reef oil fields of North and West-Central Texas. The recent discovery of oil in buried fossil reefs in Scurry County caused oil companies and educational institutions alike to call for such an investigation. Previously, oil production from reef fields had been limited and therefore little was known about the occurrence of these large porous limestone reservoirs. Now the Texas discoveries and the discovery of oil in fields of the same type in Western Canada have stimulated scientific studies of reefs everywhere. A tremendous amount of material is available for study. Recently the laboratory obtained twelve tons of cores from the Texas reef fields, and these are being subjected to basic analysis in an attempt to determine the environment under which the reefs were formed. This may provide a key to the problem of reef occurrence. Considerable knowledge of the occurrence of modern reefs has been gained in recent years by studies in the South Pacific, and it is expected that eventually some of the scientists who have been in these expeditions will be brought in for consultation. As a part of this investigation, outcropping rocks and the animal and plant life they contain also are being studied and mapped. The laboratory's work is a cooperative project sponsored by the United States Geological Survey and the University's Bureau of Economic Geology.

3. **The Mineral Technology Laboratory** is engaged in making analyses, physical or chemical or both, that contribute to or definitely establish the identification and classification of minerals and rocks being studied by the staff of The Bureau of Economic Geology.

Considerable time also is devoted to interested citizens who send in specimens for identification with inquiries as to their possible commercial value. Typical among such samples are sand for glassmaking, limestones, dolomites, and various rocks believed to contain radioactive elements.

4. **The Petroleum Engineering Oil Well Core Depository** is contributing to a systematic attack on the problem of increasing recovery of oil from Texas oil fields. Nearly 13 billion barrels of oil have been produced in Texas to date. More than 15½ billion barrels are estimated to be in our proven primary reserves. Competent authorities estimate another 15½ billion barrels of oil exist in already proved territory that cannot be recovered by methods now in use.

The depository contains a complete set of cores from the Woodbine sand of the Cayuga oil field. It is believed to be the only complete set of cores from one field in existence. This material is being studied by members of the Petroleum Engineering Department with particular emphasis on determining the number and sizes of pore systems and their classification, and the effect of freezing when cores contain salt water and oil. The practice of core freezing has been widespread for several years because it permits their transfer to laboratories with their full fluid content, but no scientific work has yet been published setting out whether the freeze process affects the porosity or permeability of the core material to the extent that the frozen sample would not be representative of the field formation.

5. The mass spectrometry section of the **Spectroscopy Laboratory** brings electronics into the field of research applicable to the oil industry. Research activities of this section are centered about the problem of determining the energies required to ionize molecules and the energies required to break the chemical bonds in the molecules, particularly in hydrocarbons. For this purpose a mass spectrometer is used. Molecules under investigation are bombarded with electrons of controlled energy from which can be determined the ionization potentials of the molecules and the bond strengths of atoms in the molecules.

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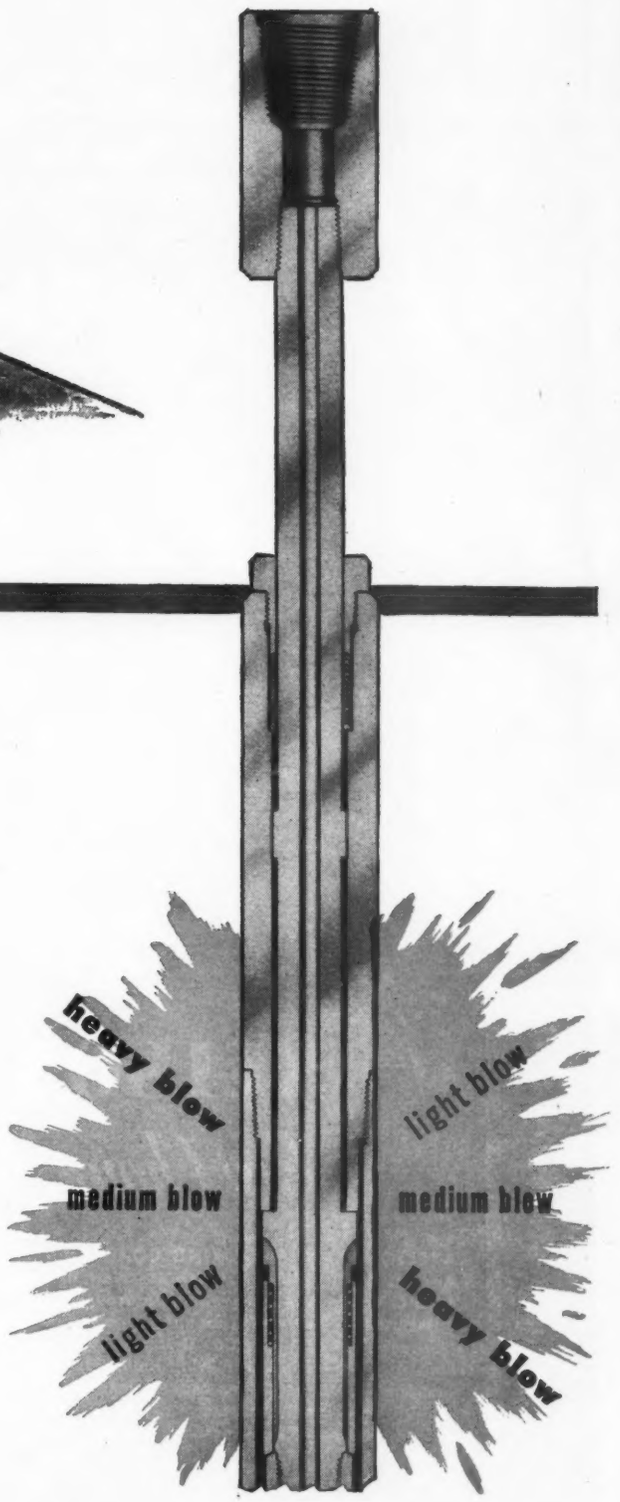

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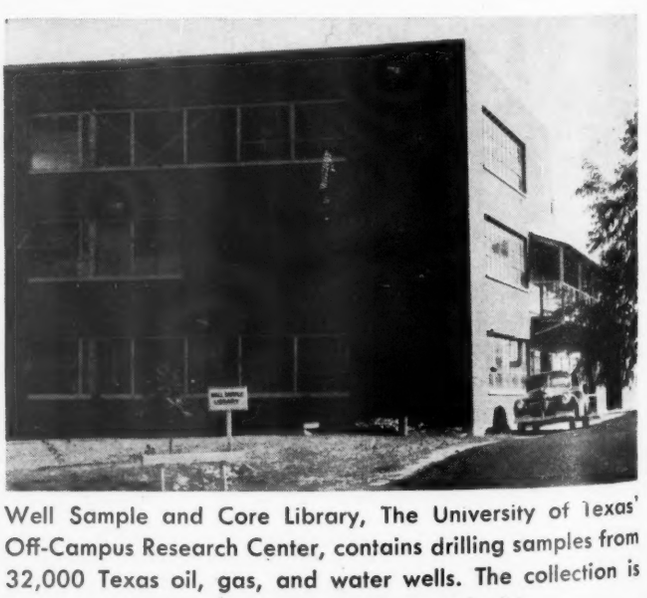
Dr. J. T. Lonsdale
Director, Economic Geology

J. Neils Thompson
Director, Research Center

volve chemical reactions, and in particular ionic chemical reactions, knowledge of bond strengths, and of ionization energies can be of considerable value in interpreting the mechanisms of reactions presently in use and in predicting new reactions which might be of value.

The emission spectrographic section of the same laboratory also employs techniques of widespread practical use.

6. **The Electrical Engineering Research Laboratory** since World War II has devoted much of its time to a study of the propagation of radio waves through to lower atmosphere. This work is sponsored by the Office of Naval Research and has a direct bearing on national defense. But information that has resulted from these studies for the Navy is also of interest to the oil industry because of the development of off-shore drilling in the Texas tidelands. As an example, extensive radio wave propagation and meteorological investigations were made by the laboratory's staff along the Gulf Coast and over coastal waters. These were recognized as significant to the industry in that it, too, is concerned with the propagation of radio waves over the Gulf because of problems arising in such areas as communications, navigation and radar storm detection. * * *



Well Sample and Core Library, The University of Texas' Off-Campus Research Center, contains drilling samples from 32,000 Texas oil, gas, and water wells. The collection is used by many oil company geologists.

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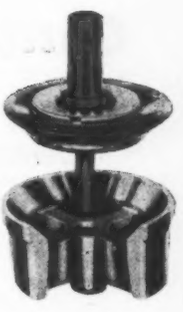

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FIG. 1. One of the parallel string paraffin control systems in operation on a pumping well in the South Cowden field of Ector County, Texas. The oil production is pumped up through the 1-in. tubing (at left of the 2-in. tubing string through which the rods are operating); through the special valve used for inserting the soluble plugs; and on out through the 2-in. flow line that returns to the ground and carries the oil on to the stock tanks. The 1-in. piping serves to fill the 65-gal. barrel-type oil reservoir behind the A-frame of the pumping unit, which supplies oil to the beam-operated pump that is used to pump the soluble plugs down through the 1-in. tubing after insertion in the special valve.

Soluble Plug Systems Used to Control Paraffin Deposition

Operators reduce downtime and the expense of cleaning paraffin out of tubing and lease lines

K. MARSHALL FAGIN*

THROUGH the installation of soluble plug injector valves[1] and means for flowing or pumping one or two soluble plugs[1] through the tubing and/or flowlines every week, many operators have found that serious paraffin deposition can be controlled effectively at a very nominal cost. These soluble plug injection systems have been designed for and installed on pumping wells, flowing wells, gas-lift wells, and lead lines from the wells to the separators or stock tanks.

A "parallel-string" control system has been devised for controlling paraffin deposition in the upper part of the tubing string on pumping wells. A special cross-over tee[1] is installed on the tubing string at some point below the level where paraffin begins to accumulate in the tubing. This point varies from field to field and from well to well within a field, however, paraffin deposits are usually heaviest in the upper part of a well where gas begins to break out of solution and the formation temperatures are lower than in the oil producing zone.

A 1-in. macaroni string is then connected to the cross-over tee and run in the well parallel to the tubing string. It is clamped to the tubing at regular intervals of about 100 ft, and emerges beside the tubing (see Figs. 1, 2, and 3) through a special parallel-string tubing head.

A plug injector valve is installed on the top of the 1-in. tubing string, and the lead line from the well is connected to a 2-in. tee above the injector valve. A 1-in. supply line is run from a swedge above the 2-in. tee over to the 65-gal supply tank, which is set behind the A-frame of the pumping unit (see Fig. 2). A 1-in. bypass line, which helps support the supply line, is run down below the cover on the cellar floor and is connected to the main tubing string.

A simple beam-operated hydraulic pump is mounted at the front of the pumping unit A-frame for use when injecting and pumping a soluble plug down through the 1-in. tubing string. Oil from the 65-gal tank is pumped down through the injector valve, forcing the soluble plug ahead of it, and thus removing paraffin deposits from the 1-in. tubing.

Pumping wells equipped with the

*Editor, Drilling and Producing.

[1]Manufactured by Kinney Machine & Manufacturing Co., Odessa, Texas.

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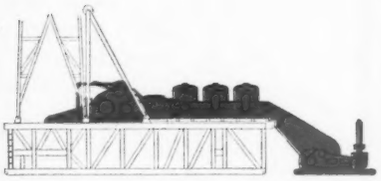

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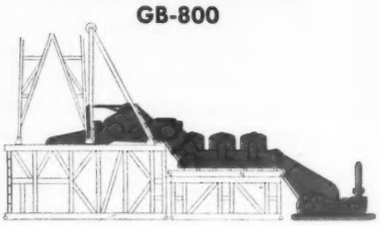
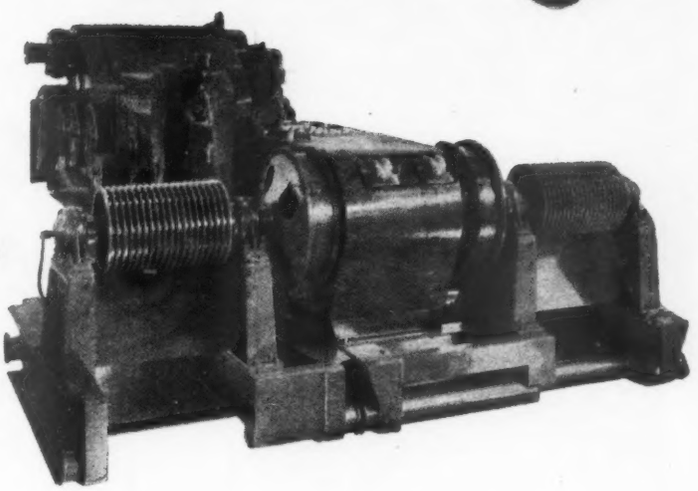
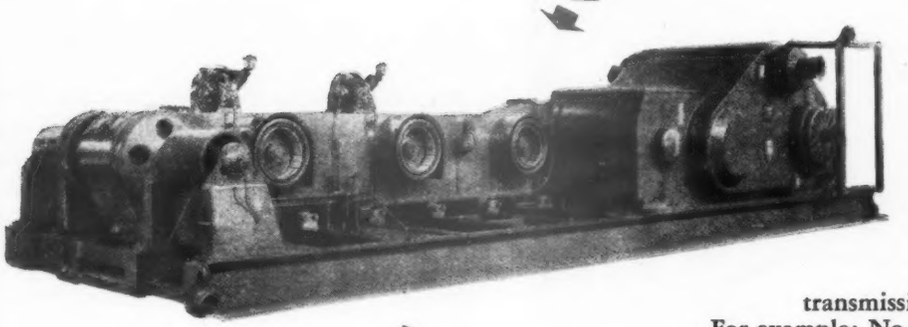


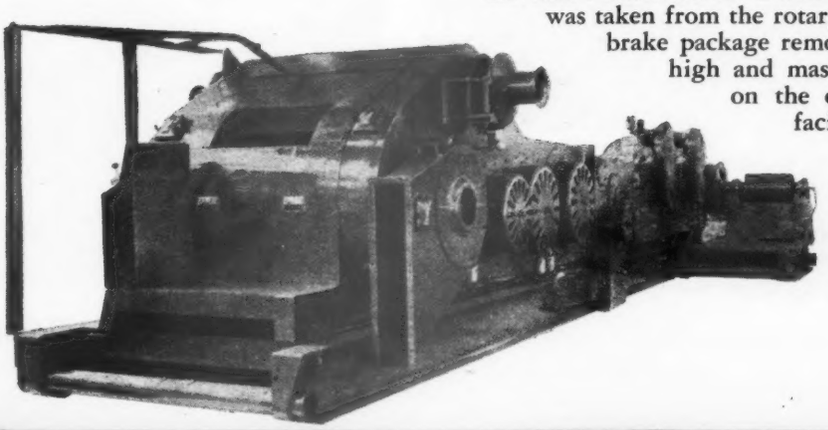
TWO-PACKAGE . . .
single-step GB-800



In Line and Individually Driven Pump Drives. This view shows the double pump drives located at the back of the compounding transmission. The pumps may be driven simultaneously at different speeds. Their position eliminates the need for notching the substructure or using belt idlers, and permits mounting the two pumps in line, simplifying manifolding.



Easier, Faster Engine Installation. Use of Airflex clutches eliminates mechanical connections between the engines and transmission, simplifying the removal and installation of the engines. During this operation it is not necessary to disturb oil lines, air lines or chains. Once aligned, no realignment of the engines is required. Many power flow combinations are possible when a 3-engine, 2-pump compounding transmission is used, such as is pictured here. For example: No. 2 and No. 3 engines may be used, separately, to drive their respective pumps at different speeds, or may be compounded to drive either pump or both pumps.



Clutches Positioned for Easier Maintenance. This photograph was taken from the rotary side, with the Emsco auxiliary brake package removed. It shows the rotary, drum high and master direct air clutches mounted on the outboard ends of the shafts to facilitate maintenance. Also shown is the auxiliary washdown pump drive, provision for driving the Thyrite generator, and the three Emsco herringbone gear-type oil pumps used in pressure lubrication system.

Printed in U. S. A. Adv. No. 110-51

FIG. 2. Another parallel string paraffin control system in operation on a well in the North Cowden field of Ector County. The latch-type connection on the underside of the walking beam enables the pumper to connect and disconnect the hydraulic pump without stopping the pumping unit.

parallel string system of paraffin control are normally pumped through the 1-in. tubing string. The upper portion of the main tubing string is thus closed off to production, so that very little, if any, paraffin is deposited in it above the 1-in. cross-over tee even though the fluid level changes.

The plug injector should be used to avoid damage to the soluble plugs, for unless proper provision is made to get the plugs into the flow line, plugging of the flow line may result.

Almost all paraffin deposition then takes place in the 1-in. parallel string, and this is broken up and pumped out after each running of a soluble plug. After the plug is through the paraffin that may have been deposited in the 1-in. tubing, the injection pressure drop is noted on the pressure gage, and the flow of oil from the hydraulic pump is switched through the by-pass line into the main tubing string. Oil is then pumped into the main tubing while production from the well is switched through the 1-in. parallel string. The soluble plug is thus pumped back out of the 1-in. string and on into the flow line, where it dissolves in a few hours. The oil supply tank is then refilled for use when the next plug is run.

A 9500-ft reef lime pumping well*

*Sunray Oil Company's Brown No. 1.

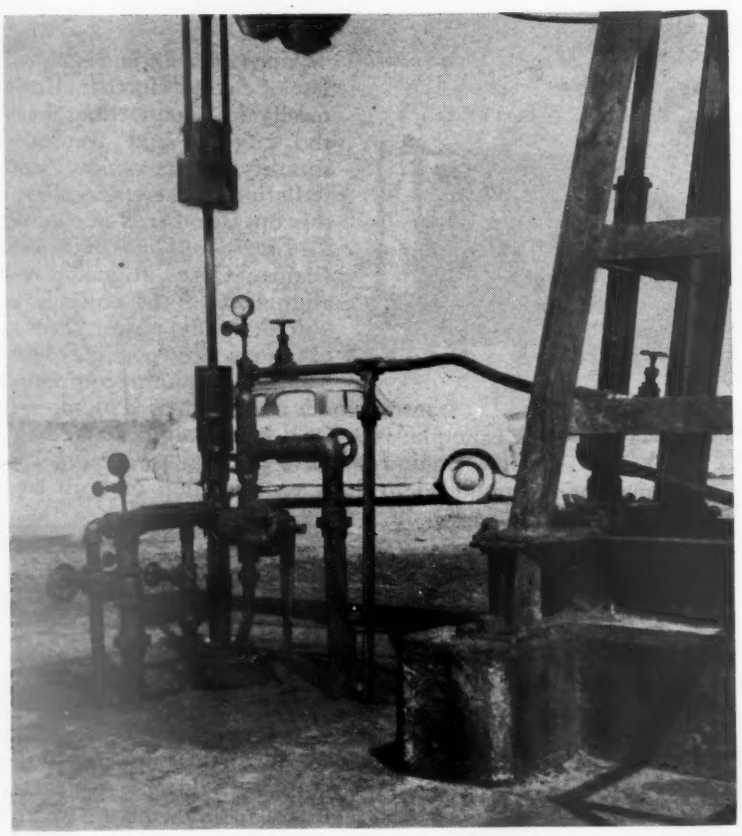
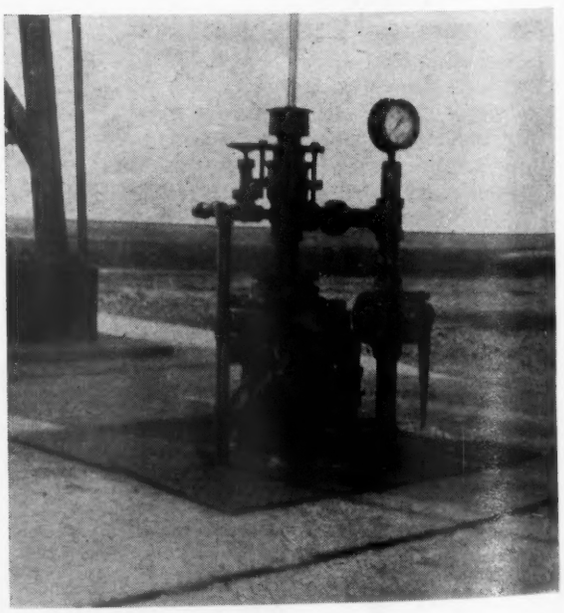


FIG. 3. After a quarter turn of the plug injector valve, the flat plug on the valve can be removed and a soluble plug injected without leakage of oil. The flat plug is then replaced, the valve turned back a quarter of a turn, and the hydraulic pump engaged to pump the plug down the 1-in. tubing.

FIG. 4. A soluble plug injector valve installed on the lead line of a pumping well in the North Snyder field of Scurry County, Texas. Plugs are inserted periodically in this valve to control paraffin deposition in the flow line to the stock tanks.



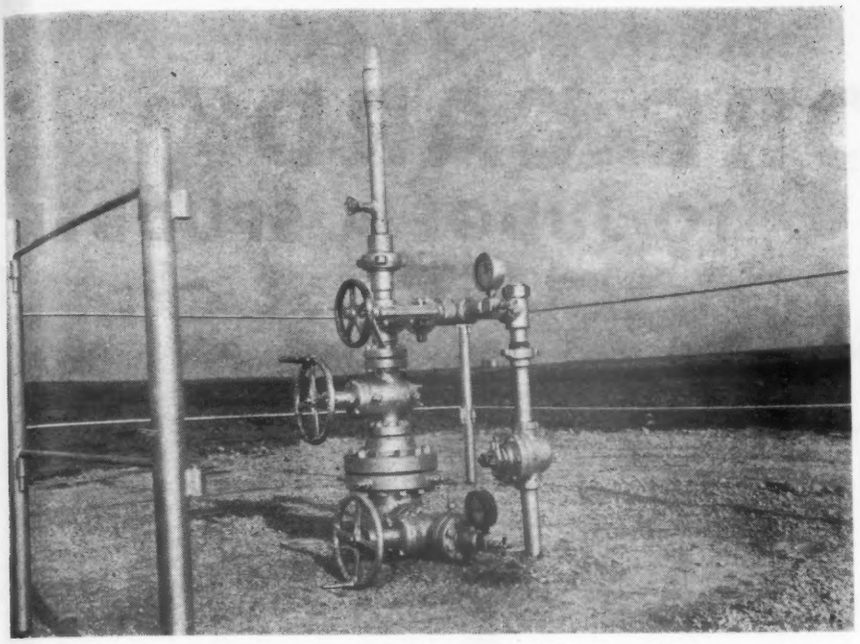


FIG. 5. Soluble plugs are injected periodically in the lead lines from flowing wells like this in the North Snyder field of Scurry County by closing the tubing gate and the valve on the lead line (right). The flat plug in the top of the 2-in. tee (behind the tubing pressure gauge) is removed, and the plug is inserted into the lead line. The flat plug is replaced and the valves are reopened. The well pressure then forces the soluble plug on through the 2-in. flow line to the separator at the tank battery.

near Lamesa, Texas, provides a typical example of the effectiveness of the parallel string system. The well produced 40 deg API oil and some water from a subsurface pumping depth of 7500 ft. Paraffin accumulation in the upper 2000 ft of the tubing caused a serious loss of producing time and expense for pulling and cleaning out every month.

A parallel string of 1-in. tubing was installed to a depth of about 2,000 ft, and one soluble plug was run every week. Thereafter, the well was pumped for several months without loss of time due to paraffin deposition. When it was pulled recently for repairing the pump, the rods and tubing above 2000 ft were found to be almost free of paraffin, and only a small accumlation was noted on the rods below that depth.

The cost of installing a parallel string system is nominal when operators count only the small extra cost of adding it when a well is being pulled to remove paraffin accumulations or to repair the subsurface pumping system.

Soluble plug paraffin control systems are being installed by several operators on both pumping and flowing wells in the Scurry County Reef fields as shown in the accompanying photos. Most of those installations now are for the purpose of injecting soluble plugs into the flow lines from the wells to the separators, however, as the working fluid level declines in the pumping wells in the field, paraffin accumulations in the upper part of the tubing strings may require measures, such as the parallel string system, for control of the paraffin deposition.

Soluble plugs are designed for pumping through pipe and tubing of various sizes and for pumping through standard and extra heavy ells and other connections that may be used on the lines. Where considerable paraffin accumulation is likely to be present in a line, or when little extra pressure is available for forcing the plug along, operators have found it best to pump a small plug through first and to follow it with consecutively larger plugs until the line is cleaned out sufficiently for setting up a schedule with the proper-sized plug.

Thus, a 2-in. flow line may be cleaned first with a 1-in. plug, then a 1½-in. plug, and finally a 2-in. plug. This procedure may save moving in a portable pump or making other arrangements to force a plug through a line that has heavy paraffin deposition. * * *

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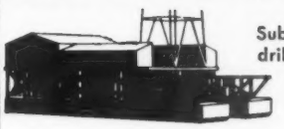

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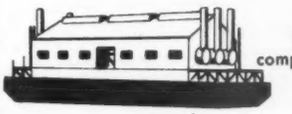

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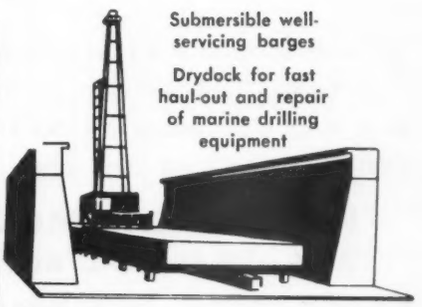

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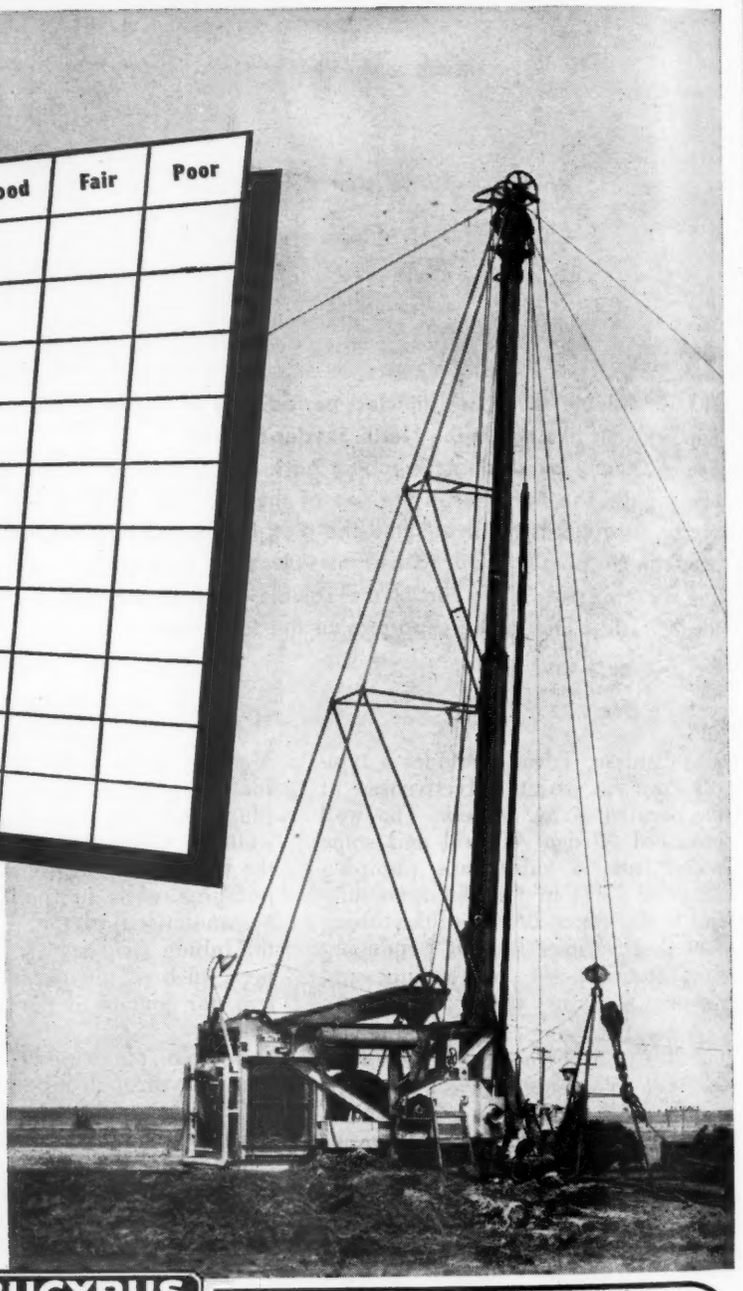

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New Developments in Diamond Coring†

Diamond core heads used in conjunction with rock bits aid in keeping bores vertical in soft, steeply dipping shales

ROBERT A. WATSON*

THE story of diamond coring has been related in many ways, many times, since diamond coring in oil wells was begun in its present form about six years ago in West Edmond, Oklahoma. Most operators and drilling contractors are familiar with the story, however, it might be in order to review briefly some of the highlights of the story and the several qualities of diamonds now in use by the oil industry.

Almost all diamonds are imported from Africa (via a detour through the British Isles) and are sold to the diamond equipment manufacturers through brokers. The source of supply is identical to one and all, and prices are standardized regardless of the size of purchase. Manufacturers of diamond equipment, through long experience in appraisal and usage of diamonds, have set up their own individual price and usage standards, and among reputable manufacturers these standards are relatively the same.

In the not too distant past there was presented to the oil industry a large amount of sales propaganda regarding the tremendous savings to be effected by the usage of so-called "cheap" diamonds in core bits. Although it was proved by subsequent experience that in some few areas actual savings could be made by the usage of the cheaper diamonds, it was proved as well that cheaper diamonds were of inferior quality for coring purposes in many areas and actually increased the coring costs! The point to remember is simply that purchasing diamonds is similar to buying any other commodity that is sold in varying degrees of quality; you get what you pay for, no more, no less.

To begin a discussion of some of the newer developments, diamonds are increasingly in use as a tool for "making hole" in those areas where the life of a rockbit is short. In these areas the formations to be penetrated are hard, thick, and usually deep. Special problems such as either very high or very low circulation rates occasioned by the condition of the hole have been solved by special bit and core barrel designs.

As there have been papers presented regarding the relative economics of full-hole diamond coring as compared with conventional drilling methods, this phase of the newer developments will not be amplified. It might be well to note, however, that some members of the industry who are not completely familiar with diamond coring appear to have the impression that diamonds as a coring tool are to be used only in hard formations. Actually, diamonds were designed originally to effect full recovery in very soft formations, and their usage in the harder formations has developed as time went by. Further, a formation so soft that full recovery cannot be obtained is yet to be encountered.

We are all familiar with the difficulties surrounding the drilling of steeply-dipping shale formations via the rockbit method. The Springer Shale in Southern Oklahoma is a notable example of such a drilling problem. Holes go off up-dip, whipstocking is frequent, and trips to change rockbits are all too numerous.

To aid in combating this problem a shale tool, or "straight-hole" tool (see Fig. 1), has been developed. This consists of a diamond core bit, full-hole size, with a rockbit placed inside and directly above. The rockbit's function is to chew up the core that is cut by the diamond bit. The assembly is made up to the drill collar with a short sub. With this tool it is possible to make hole rapidly in the steeply-dipping shale, and, in every usage to date, the hole has been brought back toward the perpendicular from its drift up-dip. The tool may be used in any soft, steeply-dipping formation; it is not recommended for usage in hard, abrasive formations.

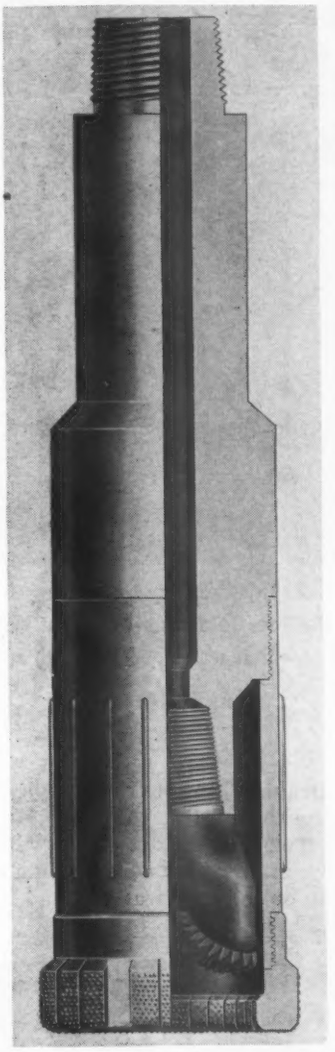

FIG. 1. "Straight-hole" tool for use in steeply dipping soft shale sections combines a diamond coring bit with a rock bit, which drills up the core.

Whipstocking with diamond core bits is not new, but it is notable that this usage is becoming more and more prevalent. One outstanding example is the job done in a Texas Panhandle well in which 19 mills succeeded only in wearing a shoulder in the permanent whipstock. A regular diamond core bit and barrel were run and recovered, along with a core of the formation a long, sword-shaped piece of the whipstock, which was cut in the process of taking off at the desired angle. More recently, an operator cut a window in 6⅝-in. pipe and set a

†Substance of a recent talk before The Petroleum Engineers' Club of Dallas, Texas.

*Sales and Service Engineer, Drilling & Service, Inc., Dallas, Texas.

FIG. 2. This was the bottom of the "fish." Notice how much of the tool joint has been cut down by the diamond rotary shoe, which was used to wash over.

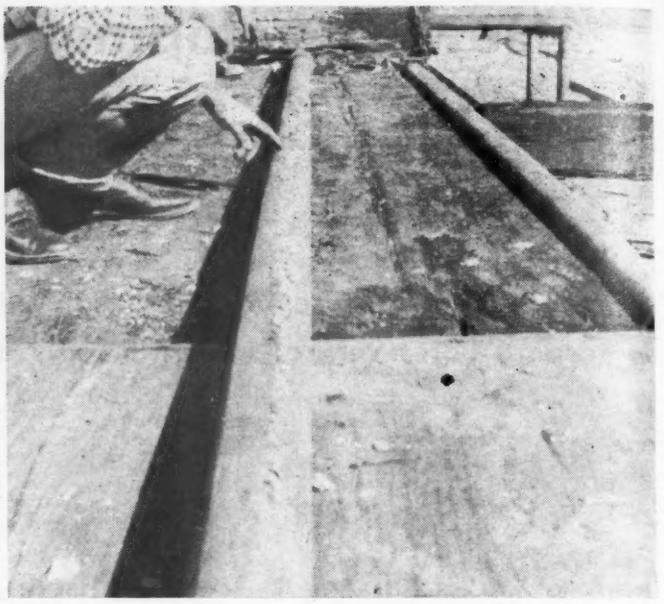

FIG. 3. Operator points to long section of cement recovered by a diamond coring bit used to drill over a section of drill pipe that was cemented in the hole.

removable whipstock. Thirty days and 27 rockbits later, the operator was still trying to get out of the window. A 5⅝-in. diamond core bit on a regulation core barrel was run and began to drill ahead at the rate of ten minutes per foot.

Diamond rotary shoes are proving very economical in drilling over "fish" in many instances. Recently in West Texas, an operator left three joints of 4½-in. drill stem in the hole, along with a drill-stem testing tool. After spending about 30 days running every style conventional rotary

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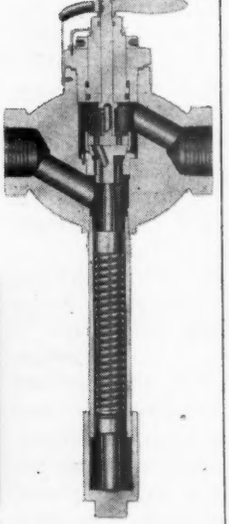

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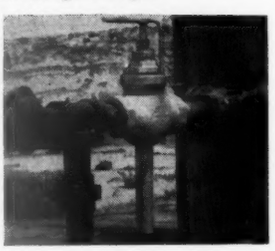

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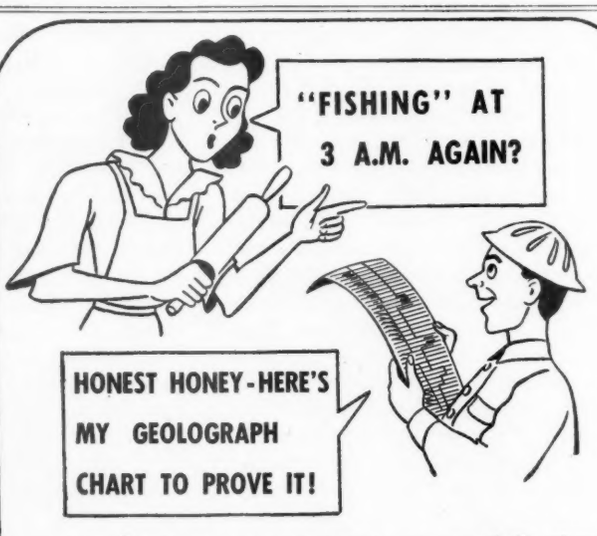

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shoe obtainable, the operator began the use of diamond rotary shoes. Two of these were used in cutting to bottom. Long sections of the drill pipe were shaved off in the process (see Fig. 2). The cutting time of the operation was much more rapid than one would expect, and needles to say, this operator was very pleased with the results.

Diamond Bits Improved

It should be pointed out that new developments in bit design, matrix content, and barrel design have contributed greatly toward the solution of the special problems that are now being solved as routine matters. In the early days of diamond coring, using the soft matrix and early bit designs, such usages would have been impossible.

One of the most recent developments concerns wire-line diamond coring, which has heretofore been just out of reach. Several years ago, after many thousands of dollars had been spent in fruitless efforts, wire-line coring with diamond bits was virtually abandoned, although not forgotten. Through the years some experimentation has been continued and in the very recent past, utilizing the latest developments in matrix and bit design, plus improved coring techniques, some success has been obtained. Although these techniques are still in the experimental stage, the results look promising, and it is believed that wire-line diamond coring might be accomplished effectively in some areas now. It is hoped that good news may be given to the industry soon because coring by the wire-line method is most desirable in many instances.

Contract Coring

One of the diamond coring usages being presented to the industry today as a new development is coring done under contract—the "so-many-dollars-per-foot" method. This is by no means a new development, for oral discussions regarding the relative merits of contract coring versus coring with purchased equipment have been held for several years. It is possible, however, that a discussion of these relative merits has not appeared in print prior to this time.

First, what are the hazards involved in diamond coring? One, and probably the greatest one, is the presence of junk iron, chert, and/or other foreign materials in the hole that will damage the diamond bit over and above normal wear. Second, the hazard of formations so hard and abrasive that the life of a diamond bit is short, with resultant low foot-

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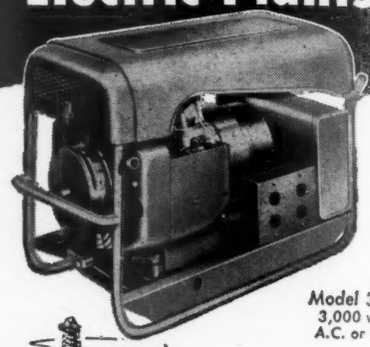

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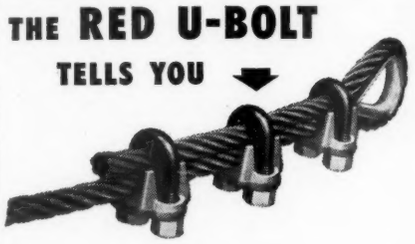

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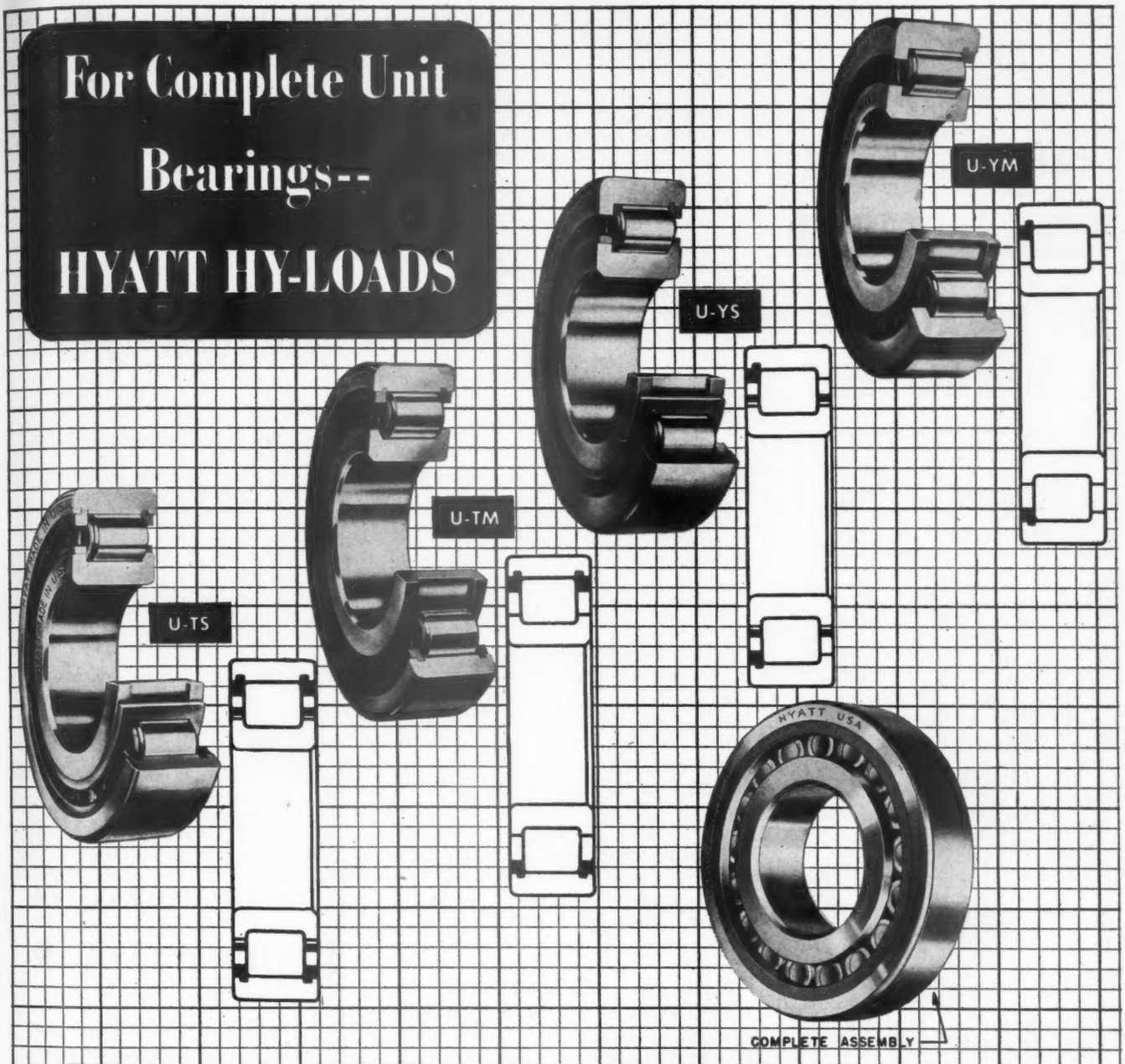

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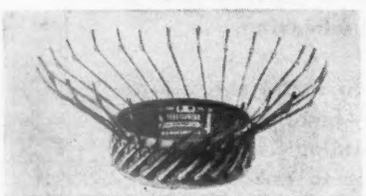

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ages and high costs. Third, the hazard of core barrel failure and a resultant fishing job.

A company or individual that purchases diamond bits and core barrels assumes all these hazards. If the coring is done by a contractor, does he reduce the responsibility of the operator by assuming any of or all these hazards? No; he assumes none of them. He must be guaranteed a clean hole; he carefully includes a "back-out" clause in the contract that may be exercised if, in *his* opinion the formation is wearing out his bits too rapidly, and he assumes no responsibility for the core barrel.

Operator's Hazards

In other words, the operator assumes all the hazards in using either owned equipment or contract equipment, and when contracting he underwrites the operation, actually guaranteeing the contractor a profit! Why should the operator bear the additional expense of the contractor's profit margin?

There is yet another hazard in contract coring for which the operator is liable and of which he is rarely aware, for reasons that should become obvious. In order for the contractor to achieve the maximum profit from his operations, the diamond bit must cut several hundred feet of core, and thus must be used in several wells for several operators. As the bit dulls through usage, the cutting time per foot increases. As a result the operator in whose well a dull bit is being used is paying much more per foot than he should in rig time, which is probably the greatest single cost item.

For example, a rig that costs $800 per day is costing $0.55 per minute. An increase of 10 minutes per foot in coring time may result from usage of a dull bit. Such an increase is by no means unusual and it may cost that operator as much as $5.50 per foot more than it would with a new bit.

Contractor's Savings

The contractor predicts the time to retire the diamond bit, so the operator who is fortunate enough to receive usage of the bit while it is new receives the full benefit of the rapid coring time and resultant saving in rig time. The unlucky operator in whose well the dulled bit is used, however, is penalized heavily by the slow cutting time, and, as shown previously, this is a substantial cost. The additional cost hazard that is occasioned by the use of a dull bit does not exist when the equipment is purchased, since it is a simple matter for the operator to determine through experience the proper time to replace the diamond bit, both from the standpoint of cutting time and diamond salvage content.

In isolated instances brought about by personnel and management problems, and for the small operator who cores but a small amount each year, coring by contract is believed to be advantageous, however, for companies or individuals that have a number of rigs and coring operations being performed annually, it has been found more economical to purchase the diamond coring equipment rather than to contract the coring by the "so-many-dollars-per-foot" method.* * *

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A Review

Casing String Design Principles and Practices†

J. O. HILLS*

IN TWO PARTS—PART 1

MOST of the principles involved in engineering design of casing strings were analyzed by Coberly[1] in 1929, but for some time thereafter such principles could not be applied effectively because of lack of dependable minimum strength data for casing. It was not until 1941 that a great deal of theoretical and practical investigation on the part of both the pipe industry and the oil industry culminated in publication by the API of minimum strengths of casing in collapse, tension, and bursting.[2-11] Today the engineered casing string is the rule rather than the exception, and the advantages of economy and safety gained by proper engineering design are generally recognized.

This paper is a review and summary of the principles and practice of casing string design and a discussion of means of choosing and utilizing the necessary data and assumptions. It is hoped that the material will be of value not only to those who are new to the problem but to those who wish to review the subject and evaluate their own practices. A bibliography of previously published material is included.

As covered herein, the problem of the casing string designer is to choose, for a given size of casing, the combination of weights, grades, and types of joints that will meet drilling and producing conditions at the least cost consistent with safety. Pipe shortages increase the importance of avoiding waste, but indiscriminate reduction of safety factors and strengths is likely to result in waste not only of money and material but of manpower and oil as well.

The most important factor controlling the cost of a string of casing is the size. Factors governing this choice have been discussed in other papers,[12-16] and are not reviewed herein, but Fig. 1 can be used to compare the costs of casing strings of various sizes.

†Presented at the spring meeting of the Pacific Coast District, Division of Production, American Petroleum Institute, Biltmore Hotel, Los Angeles, California, May 10 and 11, 1951.

*General Petroleum Corporation.

General Considerations

Casing string design on an engineering basis becomes of increasing importance as well depth increases, and for very deep strings the weight of the casing must be held at a minimum not only to decrease cost but to provide safety in tension. Proper design, however, should not be restricted to deep wells, since it will result in economy and uniform safety in wells of any depth.

Conventional assumptions are often used to simplify design procedure even when the actual conditions can be evaluated with reasonable accuracy. For example, the effects of buoyancy often are not calculated and are considered to add to the safety factor. Such procedures tend to obscure the true margins of safety and make it difficult to determine the limits to which design can be carried. Lack of full knowledge of service conditions on casing strings makes it expedient to use some simplified assumptions, but the aim of design should be to do this as little as possible. A casing string is an expensive structure protecting a large investment and the cost of engineering time required for design is relatively small.

A properly designed casing string normally will consist of a number of sections of pipe, each with a different specification. It is essential that these sections be run in the well in proper order, since running even one joint in the wrong place can have disastrous consequences. Because of the difficulty of handling and the occurrence of errors, many operators in the past were reluctant to run these "combination" or "graduated" strings. Today, however, the combination string and the necessary precautions in handling and running it are generally considered a routine part of well drilling operations. It is still desirable to restrict the sections to a reasonable number and to avoid joint changes which make crossover joints necessary. It is also good practice to use at the top a joint or two of the heaviest weight pipe in the string. This tends to prevent starting tools in the hole which will not pass through the entire string, and also provides a thicker pipe wall where the landing slips are set.

All the necessary basic data on collapse, tension, and bursting strengths of API casing are available in API Bulletins 502[17] and 5A1.[18] The latter bulletin, though informational only, gives strengths for API threads on upset and specially treated ends.

All API performance data are given in terms of minimum strengths. Collapse and tension strengths are calculated by formulas derived from test results on full sized casing specimens.[17] A percentage factor arrived at by statistical analysis of the test data is applied to the "average values" from the formulas to give the published minimums. Bursting strengths are derived from Barlow's formula using API minimum yield strengths with API minimum wall thicknesses.[18]

In their 1940 report[10] recommending the adoption of minimum strength values by the API, Wescott, Dunlop, and Kemler expressed the hope and expectation that future test work and improvements in manufacture would result in adoption of higher minimum strength values. Unfortunately, such increases have not materialized, and the present API minimum strengths are those adopted in 1941.

Strength data for non-API pipe and threaded connections are obtainable from manufacturers' catalogs. Such data should be checked to determine if they are on the same basis as API strengths, although manufacturers are generally consistent in this respect.

Biaxial Stress. In applying casing strength data, the effect of combined axial and hoop stresses should be considered. This effect is important in casing string design chiefly because of the reduction of collapse strength due to the hanging weight of the pipe. The theoretical investigations of Holmquist and Nadai[7, 19] and the experimental work of Edwards and Miller[20] indicate that the effect can be represented by the relationship shown in Fig. 2. By examination of this figure it can be seen that tension always reduces the collapse strength of casing, while moderate degrees of compression will result in an increase.

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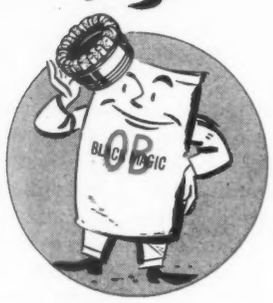
The recent use of Black Magic in a deep Gulf Coast well to combat a serious heaving shale condition was highly successful. Other jobs in similar areas have been equally startling. Black Magic's zero filtrate loss enables drilling through hydrous disintegrating shale where other methods have failed. The excellent plastering properties permits a "to gauge" hole, reduces drilling hazards and on many occasions has actually loosened stuck drill pipe. Salt, anhydrite, cement, etc. have no effect on Black Magic.



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Because of the reduced circulating rates when coring with diamonds, Black Magic is the ideal drilling fluid for this type of work. For example, in a deep Oklahoma field where extensive diamond coring was used, not one single hour of mud conditioning time was shown on any well using Black Magic, whereas water base muds required constant care and maintenance costs were prohibitive. Black Magic does not flush or alter connate water in the core and recovery of 100% can be expected.

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For detailed information on any of the above cases, see your nearest Oil Base, Inc. representative. Send for a copy of "Oil Base Drilling Fluids," a paper presented at the Third World Petroleum Congress, held at The Hague, June 1951. This paper describes in detail all phases of the subject and exhibits proof you can't afford to overlook. Ask for Bulletin 102.

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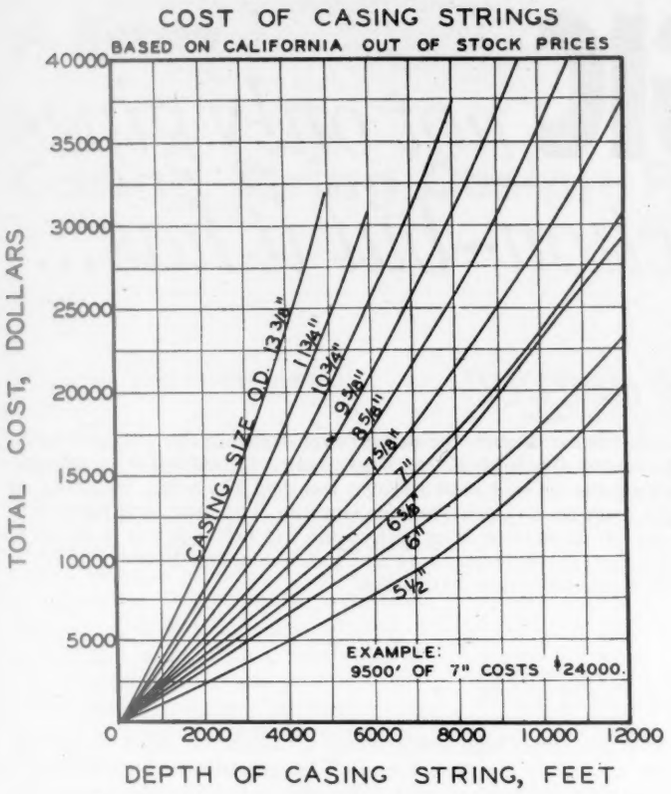

FIG. 1.

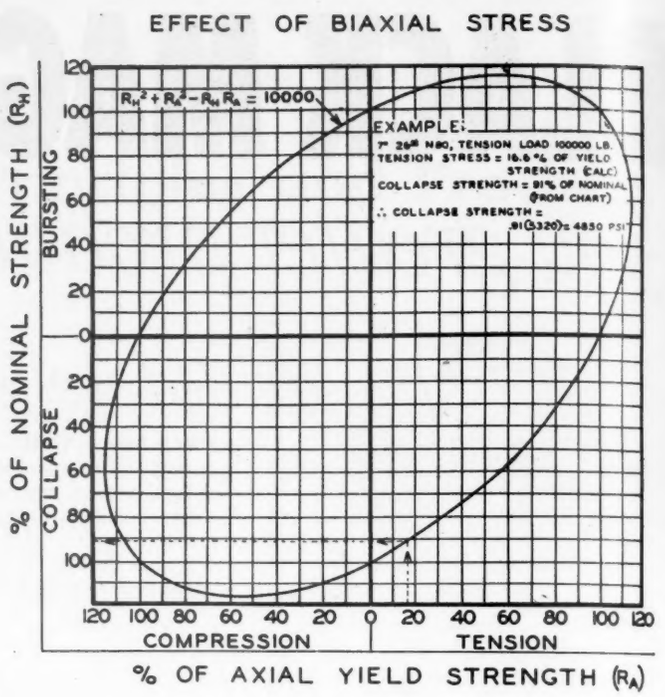

FIG. 2.

Loads on Casing Strings and Application

The three chief types of loading which casing strings must withstand are collapse, tension and bursting. The sources and characteristics of these loads and the determination of their magnitude are illustrated and discussed below. There are other considerations, however, that may be of equal or greater importance, and that are often limiting factors in the choice of casing.

These other considerations include wear, corrosion, vibration and pounding by drill pipe, effects of gun perforating, erosion, and general abuse by tools and equipment run in the well. They are not readily subject to calculation, and are met by applying the lessons of experience. This usually takes the form of specifying a minimum wall thickness or pipe weight for various casing sizes and service conditions. Tests by Oliphant and Farris[21] indicate that the stronger grades of casing resist splitting by gun perforating better than the weaker grades, and field experience seems to confirm this. Individual opinions vary considerably on these matters, but the proper approach certainly is to consider each type of case separately, specifying minimum wall thickness or strength after reviewing experience data and studying the probable importance of these considerations.

No attempt is made to design for loads caused by earth movements, since it is felt that such loads would be so large that no casing would be strong enough to withstand them. Bending and column loads on casing are not considered in design. Modern drilling practice does not permit bends in wells sharp enough to cause critical bending loads, even in directionally drilled holes. When properly handled, appreciable column loads are not imposed on casing strings.

Collapse. Collapse loading on casing strings is caused by an external pressure higher than that inside the casing and is illustrated in Fig. 3.

The most severe condition, and the one commonly used for design purposes, is represented on Fig. 3 by the mud pressure line and no internal pressure. This corresponds to a well emptied of fluid, zero pressure on the casinghead, and a full column of mud outside the casing. The casing collapse strength lines on Fig. 3 are for a string of pipe strong enough to meet this condition with a margin of safety. The strength lines slope because of the effect of biaxial stress, and are shown only for the lower sections where collapse is critical. Reduction of this maximum design pressure should be assumed only if one or more of the modifying conditions discussed below is almost a certainty.

Any internal pressure that will be maintained for the life of the well will allow a reduction of the collapse pressure to an amount indicated by the difference between the internal pressure and the mud pressure in Fig. 3. In the case of a protection string that will always be full of mud, for example, little or no collapse loading will ever be applied.

Often the mud in which the casing is run is known to be heavier than needed to balance the formation pressure. If it is certain that the mud and formation pressures will have equalized by the time the internal pressure is removed, the formation pressure can be used as the external design pressure.

Cement placed around the bottom will give some protection against collapse and may justify a slightly reduced collapse safety factor at bottom. Also favoring a lower safety factor at bottom is the fact that the internal pressure is more likely to be maintained there than further up the string.

One fairly common well operation which can result in abnormally high collapse pressure is a squeeze job as illustrated in Fig. 4. Because fluid cement in the drill pipe usually is heavier than mud in the casing, collapsing pressure imposed on the casing above the retainer may be considerably greater than surface pressure. As shown by the dotted pressure line, the collapse load can be reduced by surface pressure applied to the casing, but in wells where squeeze jobs are likely to occur, stronger than normal pipe at appropriate points should be considered.

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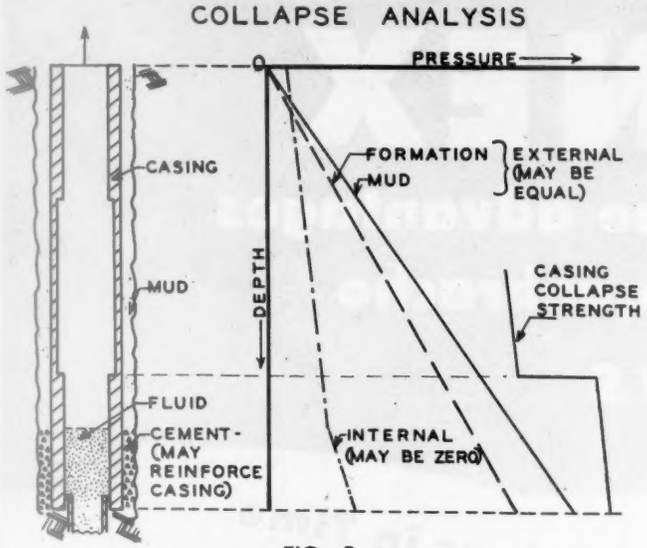

FIG. 3.

SQUEEZE JOB ANALYSIS

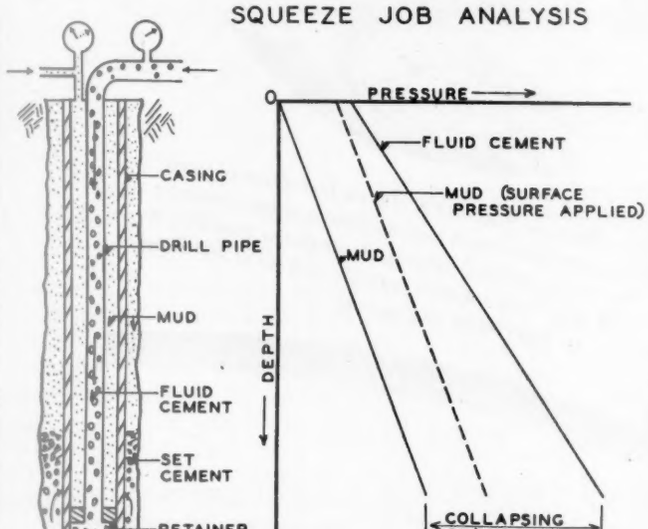

FIG. 4.

TENSION ANALYSIS

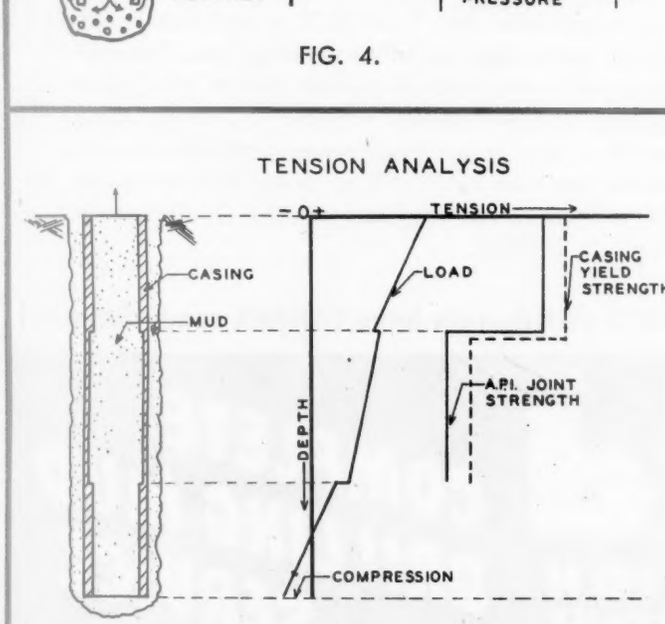

FIG. 5.

EFFECT OF BUOYANCY

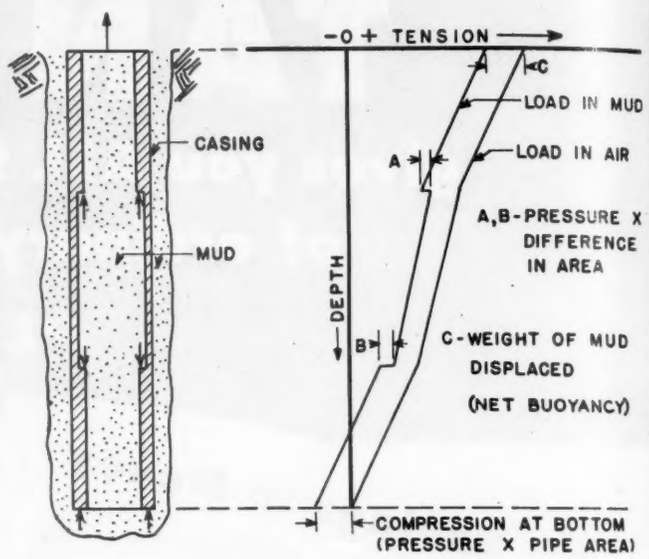

FIG. 6.

OVERPULL TO FAILURE

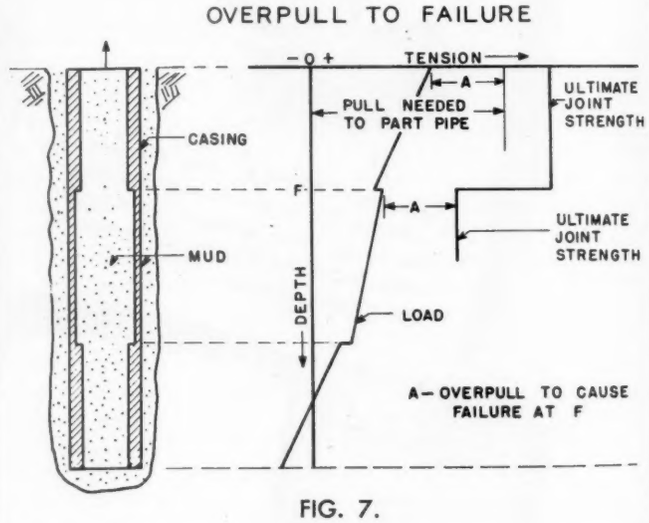

FIG. 7.

BURSTING ANALYSIS

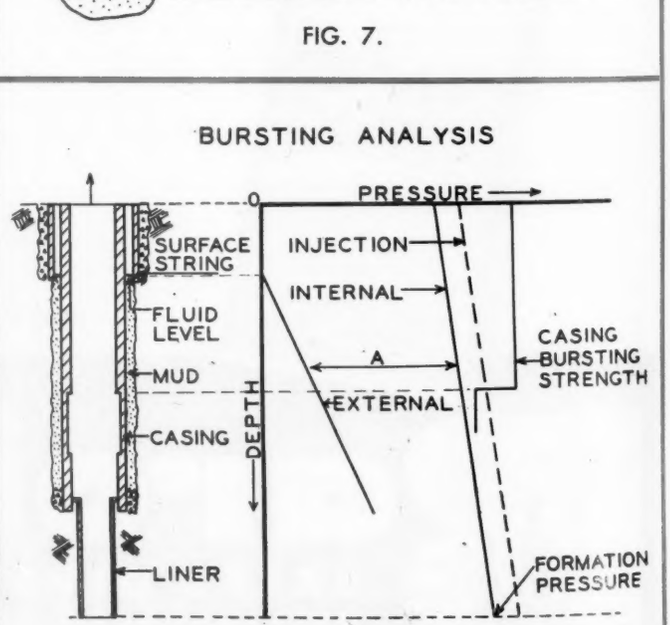

FIG. 8.

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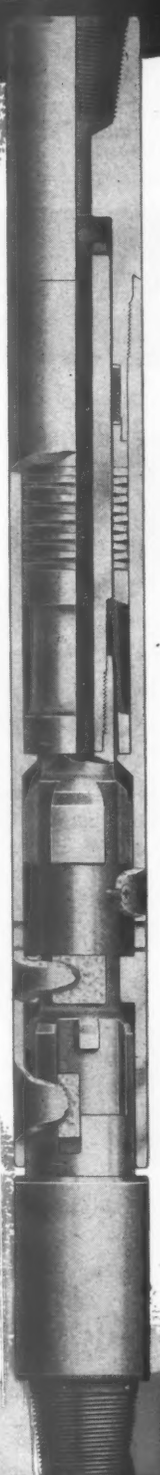

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WHAT it is!

The new Shaffer Jar Safety Joint combines—in ONE compact tool—*both* a straight-pull Jar and a quick-releasing Safety Joint. If the stuck string cannot be jarred loose, it can then be disconnected for recovery of everything above the mandrel of the Jar Safety Joint. Later, by simply using the recovered portion of the Jar Safety Joint at the bottom of the run-in string, the recovered string can be reconnected with the stuck portion for subsequent recovery operations. The tool embodies operating principles already field-proven in other Shaffer products—and has been successfully used by leading operators under a wide range of well conditions.

WHY it's better!

The Shaffer Jar Safety Joint not only combines two tools in one—thus saving extra costs and conserving space in the string—but it also provides greater safety and efficiency than assemblies of conventional single-purpose tools. Only a *single* pack-off is required . . . only *one* pin and *one* box . . . only a few simple parts that operate as a coordinated unit in place of many duplicated parts that cause multiple maintenance and operating problems. These and other advantages outlined at right mean safer, more efficient, and more economical operation!

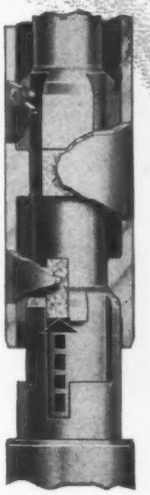
MANY APPLICATIONS

The Shaffer Jar Safety Joint is particularly recommended for use with formation testers, casing shoe tests and on fishing jobs. And, although not designed for heavy, high-speed drilling operations, it is extensively used for diamond core drilling and similar light drilling operations.

AS A JAR

The tool strikes a powerful upward blow with simply a *straight pull* on the string. *No torque or rotation of any kind is needed to strike the blow* . . . therefore, there is no interference with operation of other tools in the string. However, full torque *can* be placed in the string if desired for loosening operations—but is not necessary to operate the Jar.

- Any number of blows can be struck in rapid succession—or single blows at any desired intervals—by simply raising and lowering the string. Every time the string is lowered the tool automatically "resets." Raising the string strikes the blow—and blows may be struck *continuously* as fast as the string can be raised and lowered.
- Force of the blow is easily adjusted over a range of 10 to 60 tons in 5 ton steps, so that virtually any desired blow can be struck.
- The tripping mechanism does not depend upon friction for operation and strikes a steady, uniform blow.
- All rotational loads are carried by heavy drive keys—not by threads. Since the drive keys are stronger than the run-in string, any amount of torque can be applied to the string—in *either* direction.

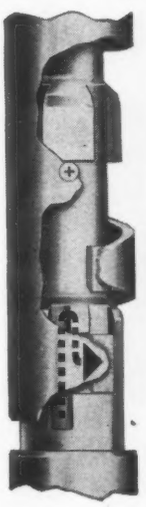


Drive keys remain in locking slot as the blow is struck

AS A SAFETY JOINT

. . . this new Shaffer tool is also superior. Since there are no tight-fitting joints or threads to "force," quick release can be effected whenever desired by simply following a few simple operations in proper sequence.

- Only 1/6th turn is needed to release the Safety Joint, eliminating risk of unscrewing other threads in the string.
- Until the Safety Joint is first made ready to release, *any* amount of torque—in *either* direction—can be applied through it without danger of release.
- At any desired time after release, the Safety Joint can be reconnected *in the hole* for further recovery operations.



Rotating drive keys into unlocking slot releases Safety Joint

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It is evident that for design purposes a maximum collapse loading can be predicted, and it is not a fatigue or impact loading.

Tension. The weight of pipe when hanging free just before cementing is the most readily calculable tension condition, and is the loading condition commonly used for design purposes. It is illustrated in Fig. 5 for a string of pipe with a light weight center section. Diagrammed at the right of the figure are API joint strengths capable of supporting the string with minimum safety factors of approximately 2.0 at the critical points. The location of the casing yield strength as shown is typical of standard API joints, for which the yield strength of the pipe body is greater than the API joint strength. For upset or other high strength joints the reverse is often true, and body yield strength rather than the strength of the joint may limit the design.

When the casing string is being run in the hole it will be subjected to acceleration loading by setting of slips and application of hoist brakes. If the string should stick it may be subjected to high tension loads in an attempt to pull it free.

Buoyancy. Fig. 6 compares the tension loading conditions of pipe hanging in air and in mud. The effect of buoyancy on pipe strings hanging in fluid has been analyzed by Klinkenberg,[22] Hawkins and Lamont,[23] Holmquist,[24] and Payne.[25] These analyses show that the effect is as shown by the "Load in Mud" curve on Fig. 6, and that the compression loading due to fluid pressure acting on the bottom does not tend to cause buckling. The load increase from the bottom of the hole upward is at the same rate as if the pipe were hanging in air. As the pipe weight (and therefore the cross-sectional area) changes at "A" and "B," the mud pressure on the differential area results in an abrupt change in load at these points. This load change is equal to the mud pressure at each point times the change in area at that point. When the greater area is in the lower section the load in the upper section is greater, and vice versa.

The net effect of buoyancy is a substantial amount, varying from about 14 per cent of the unbuoyed weight when the pipe is hanging in 70 lb per cubic foot mud to 20 per cent in 100 lb per cubic foot mud. It is felt that this effect should be included in casing string design practice.

Tension Variations in Service. Throughout its service life after cementing is started, a casing string is subjected to varying tension loads. During cementing, buoyancy of the cement will tend to decrease the load. After being landed permanently, increased internal pressure or decreased temperature will increase tensile load, while internal pressure decrease or temperature increase will have the opposite effect.*

The factors involved in landing casing and their evaluation have been investigated by De Hetre[26] and by Oberg and Masters.[27] These investigations indicate that it is important to give engineering consideration to the landing of casing. Casing should be landed at the minimum load that will not cause a dangerous degree of column loading to develop at any time. For very severe anticipated temperature and pressure changes, it may be desirable to use casing with higher tension strength than would otherwise be necessary.

Fortunately, increased tension due to temperature and pressure changes after landing casing is not likely to be accompanied by shock or acceleration loading, so the tension load can safely be higher under such conditions than while running the string. Thomas and Bartok[28] found that API joints properly made up will not leak until the tension load approaches the yield

*See Appendix for formulas.

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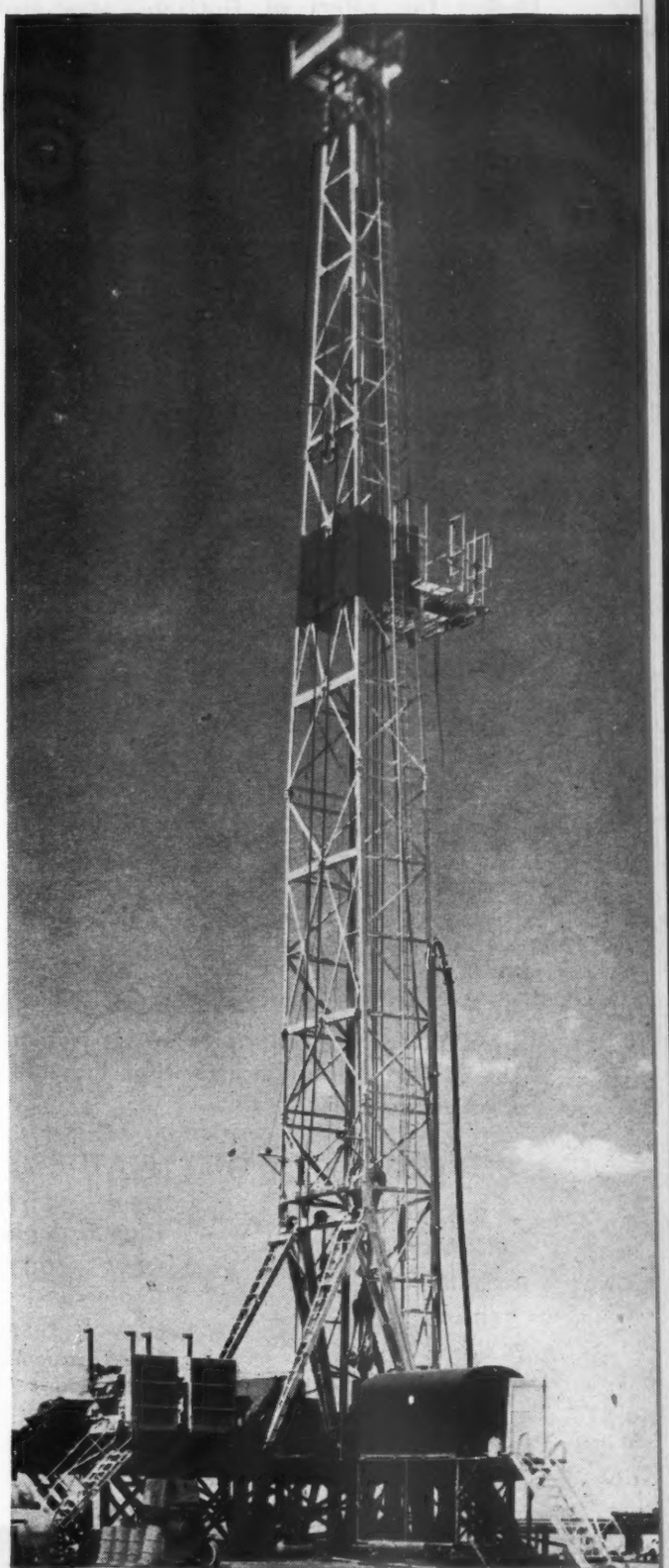

Two "Caterpillar" Diesel D375 Oilfield Engines are compounded to drive the oil well mud pump and Emsco drawworks on this 8,500-ft. rig owned by the Western Drilling Co. of Whiteface, Texas. Driller W. B. Barnett says: "For 24-hour service, efficiency and ease of operation, the two D375 Engines are the best I've ever operated." Mr. Henry Johnson of Western reports: "We have drilled 15 wells with this rig. The engines have 5,208 hours with practically no trouble of any kind."

strength in the critical section of the joint near the last engaged thread. Such a loading corresponds to a tension safety factor below 1.4.

In spite of the fine work of De Hetre and Oberg, and Masters, the problem of landing casing is not well understood, and more study and investigation is needed.

Design for Effect of Biaxial Stress. The tension loading at the time the casing is hanging free in the hole before cementing is commonly used as the basis for determining the change of collapse strength due to tension. This is a purely conventional assumption, since the casing must at least be cemented and landed before a critical collapse loading can be applied. However, it is felt that this assumption is the best available, but that the true effect of buoyancy (Fig. 6) should be included. This procedure is advocated by Curran.[29] It probably is conservative since the same condition which causes the collapse loading (reduction of internal pressure) causes further reduction of longitudinal tension. This last mentioned tension reduction can be evaluated [22, 26*] and could be included in design, but the resulting calculated increase in collapse strength may not be realized because of variation in landing practice and temperature changes. Payne[25] argues that the effects of tension on collapse strength in deep strings should be ignored because the bottom section is in compression. This does not seem to be a proper procedure, since collapse often is critical at points far off bottom where the casing definitely is in tension, and when the pipe is in compression the collapse resistance is actually increased.

Overpull to Failure. Normal design practice is to apply a uniform limiting tension safety factor throughout each string. Fig. 7 illustrates a result of this practice. Assuming that the casing at the surface and at depth F are loaded to the same safety factor, the casing at the surface must be stronger than at F as illustrated by the joint strength lines. If the string is stuck below depth F and pulled to failure, it will fail at depth F at an overpull shown as A. The total pull to failure will be less than the joint strength of the pipe at the surface. It is sometimes desirable to alter tension safety factors by making the available overpull more nearly equal at critical points.

Tension Loading Summary. It is evident that for tension a dependable maximum loading cannot be calculated because of acceleration loading and possible overpulls, but the free hanging weight of the string appears to be the best basis for design.

Bursting. Fig. 8 illustrated the factors involved in determining bursting load on a casing string. This load is equal to the excess of internal over external pressure as illustrated by differential pressure A. Diagrammed at the right are casing bursting strengths capable of meeting, with a margin of safety, the condition shown by the solid pressure lines.

The external pressure opposing bursting can be zero at the surface and perhaps for some distance down the hole, but will be at least equal to the fluid pressures in the formations surrounding the casing.

The maximum internal pressure from within the well itself would be caused by a hole full of dry gas at a bottom hole pressure equal to that of the mud used to drill the producing zone.* This is a severe condition not often encountered in California, and, when possible, design is based on expected shut-in casinghead pressures. Fortunately, the casing required to meet tension and collapse conditions usually proves strong enough for normal bursting loads. If a casing string is to be used for injection purposes it may be subjected to higher bursting pressures than indicated above, as illustrated by the broken line in Fig. 8.

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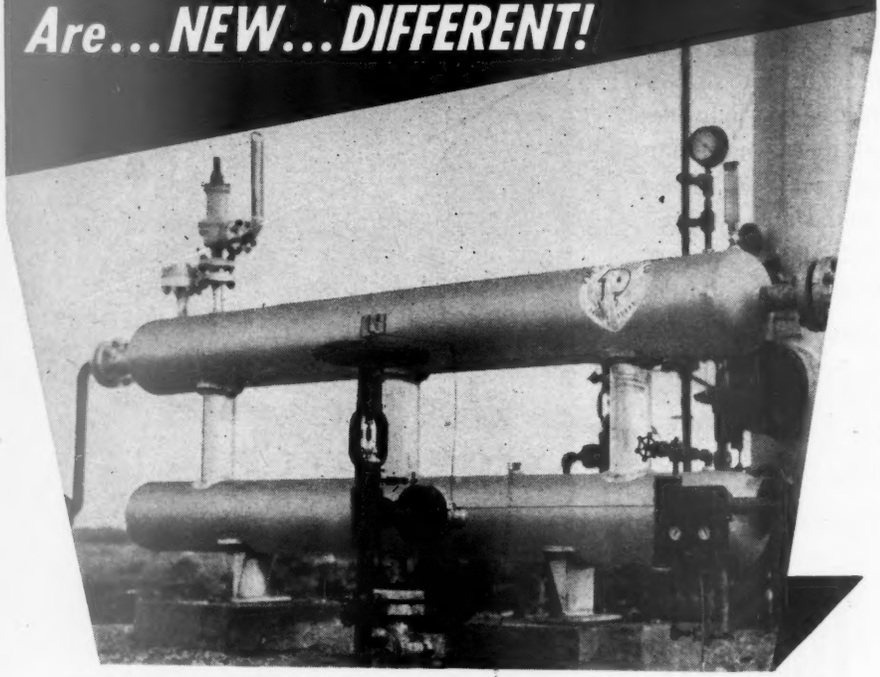

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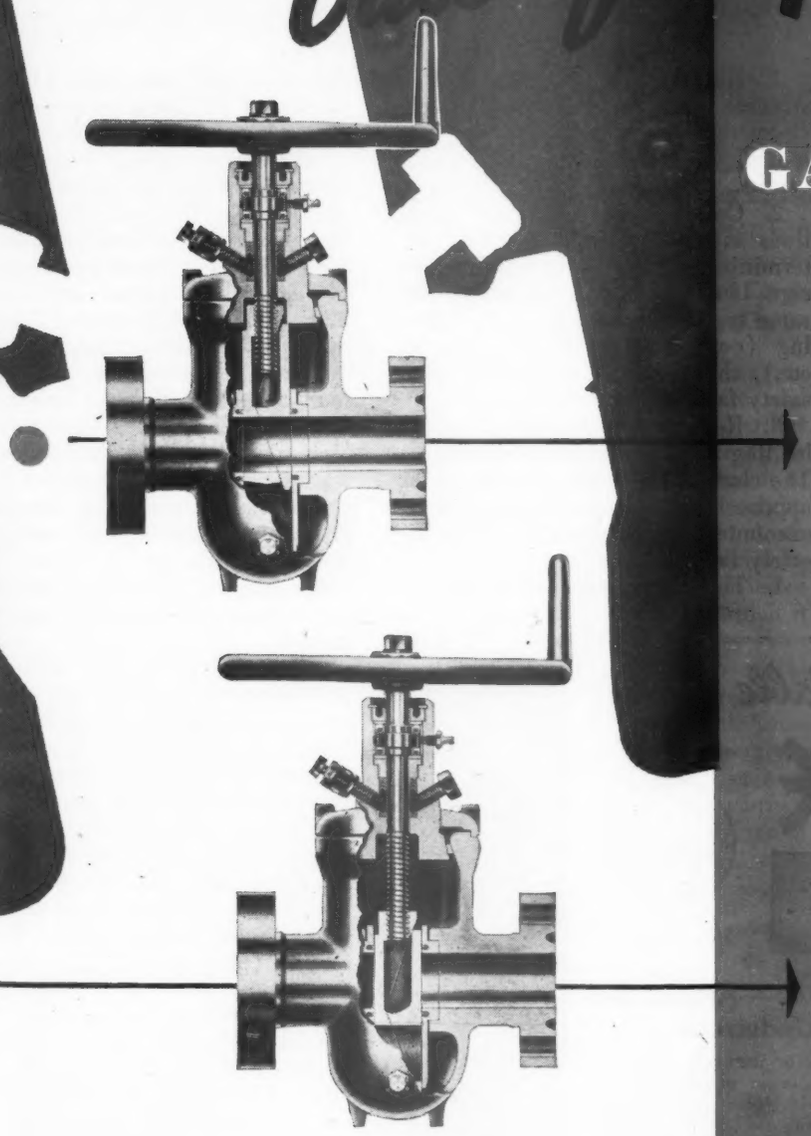

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The Expanding Gate gives a perfect seal against both seats when valve is open as well as closed.

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Predicted bursting pressures may or may not be real maximums, but there is no shock loading to consider. Surface pressure on a casing string is easily measured at any time, and may be controlled to some extent.

Types of Casing Strings

Table 1 lists the design considerations for the various types of strings run in an oil well. Complete design is most important for water shutoff (oil strings), but the loading conditions on the other types should be considered carefully.

It is apparent that the service conditions of liners and surface strings must be met chiefly by choice of adequate wall thickness, but protection strings may have to be designed on the same basis as water shutoff strings.

Safety Factors

Choice of safety factors is the responsibility of the individual operator, and depends upon the amount of insurance he wishes to buy. The decision should assume sound design which will evaluate as correctly as possible the true safety factors.

Choice of suitable factors of safety in any engineering design must be based largely on the following considerations:

TABLE 1. Types of casing strings—conditions to be considered in design.

Service condition	Surface strings	Protection strings	Water shutoff (oil) strings	Liners
Collapse	Not normally	No, if mud level always maintained inside	Yes	No
Tension	Not normally	Yes, Landing practice important	Yes, Landing practice important	No
Bursting	Yes, for blowout prevention	No, unless to be used as oil string in future	Yes	No
Internal wear	Yes (Drill pipe)	Yes (Drill pipe)	Yes (Drill pipe and tubing)	Yes (Tubing)
Corrosion	Seldom	Seldom	Yes	Yes
Gun perforating	No	Not normally	Yes	Occasionally
Fatigue	Yes (Drilling through)	Yes (Drilling through)	Yes (Drilling through)	No
Sand erosion	No	No	No	Yes

1. Reliability and accuracy of the strength data used for design. The closer these data approach true minimums, the smaller the safety factor can be.

2. Comparison of service conditions and test conditions used for determining strength data used for design. If service conditions impose the same type of loading as used in testing (considering impact, fatigue, etc.), this will tend to permit small safety factors.

3. Reliability and accuracy of the loading assumptions used for design. The closer these loading assumptions approach the maximum that can be encountered in service, the smaller the safety factor can be.

4. The consequences of failure. If failure would cause serious hazard to personnel or great economic loss, safety factors should be increased.

API casing strength data are minimum values and thus permit loadings very close to the listed strengths with little hazard of failure. However, such high loadings make it imperative that no defective material be used and make complete and careful inspection of casing very important.

When designing for collapse, the load assumed will rarely be exceeded, and is applied in the same relatively slow manner that is used in collapse testing. The consequences of failure are serious economically, but there is no hazard to personnel. Therefore, the only reason for use of a safety factor more than 1.0 is the high cost of failure, and a safety factor of 1⅛ appears ample.

When designing for tension, the load assumed is not necessarily a maximum, and acceleration loading exists. Failure would be expensive, and there is some hazard to personnel. Therefore, tension safety factors approaching 2.0 on ultimate joint strength are indicated. The factor need not be this high on yield strength of the pipe body, since yielding would not necessarily result in actual failure. A safety factor of 1.5 on body yield strength appears ample.

For bursting, maximum possible theoretical loading may or may not be assumed, failure would be expensive, and there is hazard to personnel. However, failure would result from a slowly applied load, and the strength used for design is based on yield rather than ultimate strength. Where theoretical maximum pressures are used for design, the safety factor can be about the same as for collapse, but otherwise must be higher.

Obviously, the ultimate test of the suitability of safety factors is actual application. Field experience appears to confirm that safety factors in the ranges discussed give ample safety when the conditions of wear, corrosion, etc., are considered and provided for separately. * * *

Part 2 will be published soon.

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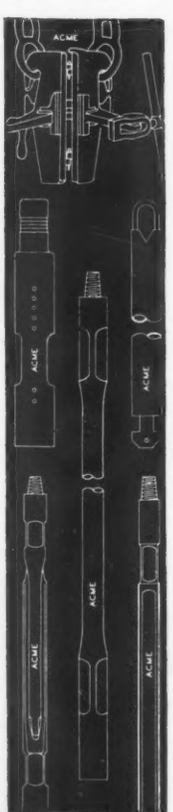
Fig. 142 — Acme 3-cutter Underreamer. 51-years' specialized "know-how" makes it worth more to YOU.



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API PAPER GIVEN ON LIGHTWEIGHT AGGREGATES AND GEL CEMENTS

ACCORDING to T. A. McElheney of International Cementers Inc., who presented a paper at a recent meeting of the Los Angeles Basin Chapter of American Petroleum Institute, gels may be used in any cement slurry between 120 and 99 lb. They can be used on long strings, lost circulation, plugs and liners.

The following percentages of gel were recommended for use as a dry mix, by weight:

117 lb .... 1½ per cent Vol. 1.16 cu ft
115 lb .... 2 per cent Vol. 1.23 cu ft
113 lb .... 2½ per cent Vol. 1.29 cu ft
111 lb .... 3 per cent Vol. 1.38 cu ft
108 lb .... 3½ per cent Vol. 1.43 cu ft
106 lb .... 4 per cent Vol. 1.52 cu ft
105 lb .... 4½ per cent Vol. 1.57 cu ft
103 lb .... 5 per cent Vol. 1.66 cu ft
102 lb .... 5½ per cent Vol. 1.69 cu ft
100 lb .... 6 per cent Vol. 1.80 cu ft
99 lb .... 6½ per cent Vol. 1.83 cu ft

Percentages as high as 20 per cent dry mix have been used effectively on lost circulation jobs. In the Ventura Avenue fields slurries of 15 per cent dry mix have been used to bring the cement back to the surface from 10,000 ft. On these jobs, slurries were adjusted to weigh about 2 lb more than the drilling fluid, however, with percentages this high, the strength is quite low and neat cement is used generally at the shoe.

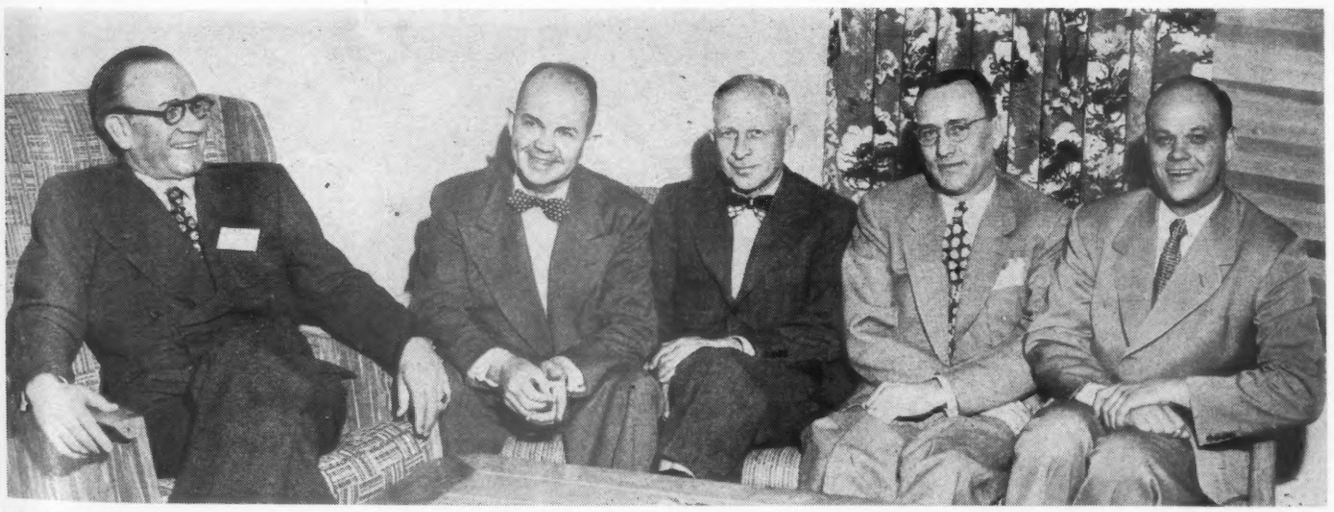
Light Weight Aggregates

There are about 15 materials that might be classed as light weight aggregates. Some of these are: Fibretex, Jelflake, Flowseal, sawdust, chicken feathers, redwood bark, cotton seed hulls, Calseal, Lumnite, and expanded Perlite. Expanded Perlites are produced from volcanic rock or ash by grinding and kiln treatment to the desired particle size and weight. Being inert, this material is not affected by storage or weather and does not change the chemical properties of the cement slurry or mud in which it is used.

Expanded Perlites may be used in all cement slurries and drilling fluid columns where low bottom hole pressures or highly permeable sections might be encountered. They act as a weight reducing medium and a bridging agent when used on operations of the following types:

1. **Surface Pipe.** To prevent loss of slurry to loose sands or crevices, thereby bringing the slurry back to the surface and preventing the possibility of blowouts around the surface pipe string.
2. **Lost Circulation.** To be added to the drilling fluid as a bridging agent or to the cement slurry to reduce the weight.
3. **Plug Jobs.** To be used on plug jobs, particularly long plugs, without increasing the bottom hole pressure. Plug jobs at the shoe of the surface pipe on abandonment jobs might not slip down as much as neat cement.
4. **Long Strings.** To reduce bottom hole pressure while raising the

Speakers at a Los Angeles Basin chapter meeting of the API are: F. M. Carlisle, Carlisle and Associates; T. A. McElheney, district superintendent, International Cementers, Inc., Bakersfield, main speaker of the evening, and Kurt Taves, Great Lakes Carbon Corporation. All three speakers discussed light weight aggregates and their use in oil well cementing.



Distinguished Service to the oil industry in the Rocky Mountain Region won citations for five western oil men at the Rocky Mountain district meeting, American Petroleum Institute, Division of Production recently. Recipients were: W. M. Saxon, representing M. R. McArthur, Husky Refining Company, Cody, Wyoming; D. T. Hoenshell, General Petroleum Corporation, Casper; J. C. Johnston, Continental Oil Company, Denver; J. D. Anderson, Ohio Oil Company, Findlay, Ohio, formerly at Casper; and Zach Brinkerhoff, Brinkerhoff Drilling, representing R. B. Curran, Imperial Oil Company, Calgary.

slurry column, to prevent loss of slurry to the zone, to combat corrosion, and to obtain better penetration while perforating on strings set through the zone.

5. **Squeeze Work.** To prevent loss of slurry in a weak zone, thereby reducing the number of jobs and gaining the desired pressure with less rig time.

, . . . Expanded Perlites have been used in 15 different states in about 120 pools since April 1949. More than 1114 jobs have been completed, 69 per cent of these jobs were in casing. About 150 jobs were completed in California during this time. The deepest job to date was in Ventura on a liner below 13,000 feet.

Saudi Arabian Output Up

Crude oil production in Saudi Arabia during April amounted to 20,853,644 bbl, or an average of 695,121 bbl per calendar day, it was announced by the Arabian American Oil Company. This compared to 19,807,079 bbl in March, an average of 638,938 bbl per calendar day.

Crude oil production for the first four months of 1951 amounted to 75,802,064 bbl, an average of 631,684 bbl per calendar day.

New American Petroleum Institute Mid-Continent district officers and one of their Amarillo hosts at the close of their annual production division meeting. Sitting: Fred J. Neslage, API Panhandle chapter chairman, one of the hosts of the meeting; Harold E. Berg, district chairman, Tulsa; Glenn M. Stearns, chairman of the district advisory committee, Tulsa. Standing: V. J. Mercier, secretary-treasurer, Wichita, Kansas; Vern Morris, vice chairman for Southwestern Oklahoma, Pauls Valley.

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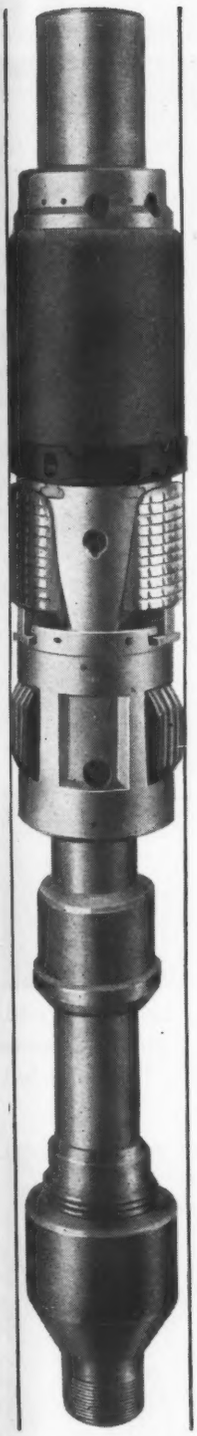

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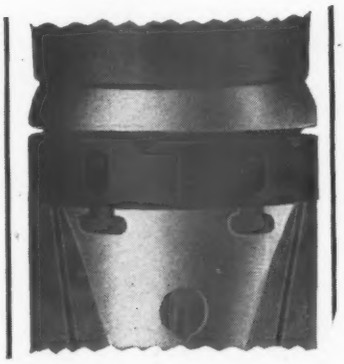

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NEWS

Iran Output Rises

Anglo-Iranian Oil Company, Ltd., has reported production of crude oil in Iran amounted to 2,837,000 long tons in March compared to 2,580,000 long tons in February. Total production for the period January 1 to March 31 was 8,041,000 long tons.

Aramco Oil Output Leads Middle East Countries

Arabian American Oil Company, which is celebrating its 12th birthday this year, recently had the largest monthly production in the Middle East, for the first time in the company's history.

Since its beginning 12 years ago, Aramco oil production has gone from 10,000 bbl to the current daily production of 685,000 bbl daily. Aramco last December 30 cut King Ibn Saud in on a 50-50 sharing of the net profits. Indications are that the agreement was well received by Saudi Arabia.

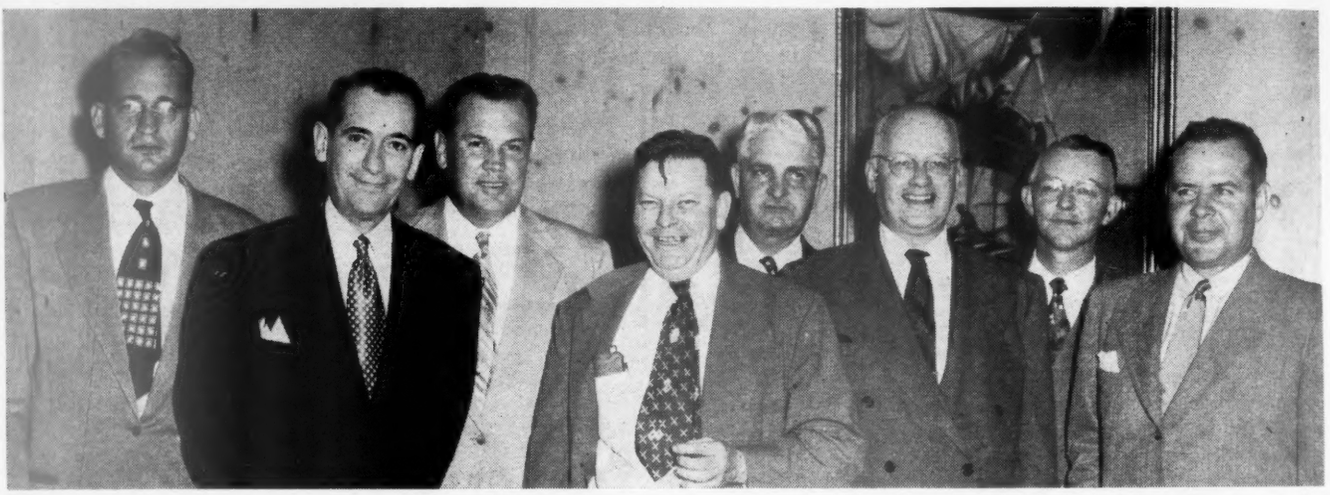
The nationalization dispute in Iran was mainly responsible for Aramco's leading the monthly production of Middle East oil countries. Anglo-Iranian Oil Company in Iran had been up to 710,000 bbl recently, but a strike at its Abadan refinery forced a cutback in April and permitted Aramco to take the lead.

A spokesman for Aramco has announced that a $75,000,000 expansion program this year will make possible a daily production of 800,000 bbl, which would top the present rate of the current biggest producer in the world, Creole Petroleum Corporation in Venezuela, whose rate is now about 750,000 bbl.

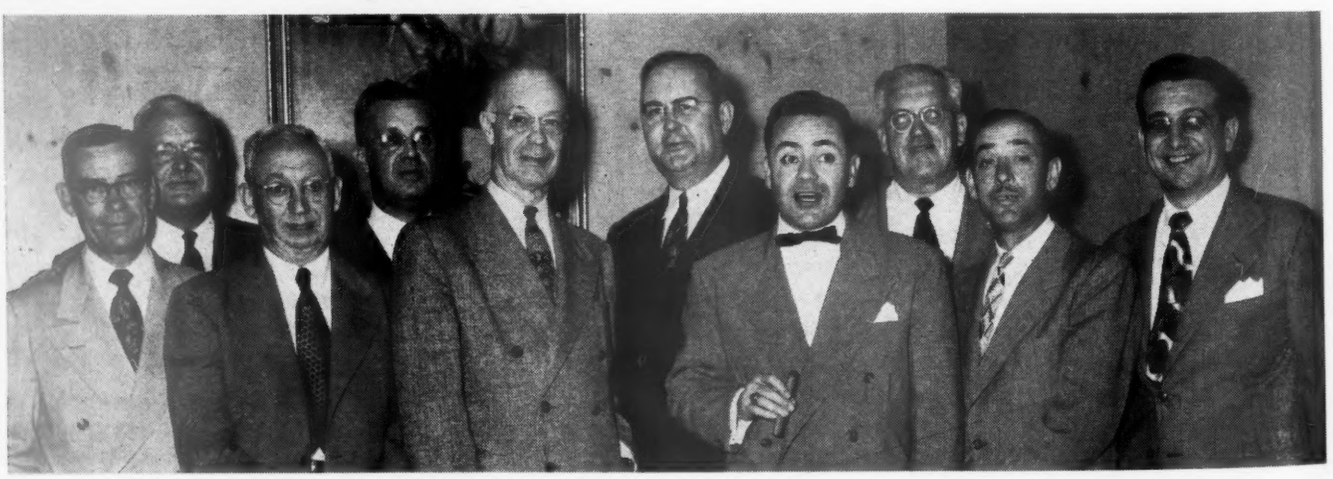
Rotary Rigs Operating in Oil Fields of United States and Canada*

Weeks (April)	Total	Gulf Coast	Pacific Coast	Oklahoma Kansas	Arkansas Louisiana Texas	Rocky Mountain, Canada	N. Mex. W. Tex.
Fourth	2492	532	150	466	142	234	842
Weeks (May)							
First	2509	548	143	450	146	236	854
Second	2547	554	145	448	146	233	873

*As reported to American Association of Oil Well Drilling Contractors by Hughes Tool Co.



Houston Nomads' Guests. Guests of the Houston Nomads, recent meeting, are: Charley Smith, Creole, Lake Maracaibo, Venezuela; Raimundo Cueevo, Implementos Petroleos, Mexico City; "Stub" Blackman, Welex; Tad Putnam, Cameron Export; Floyd "Hero" Palmer, Bariod Sales; Robert C. Kelley, Dresser Industries; J. R. Jancey, A-1 Bit and Tool, and Jack Higgenbotham, Republic Steel Company.



PAD Head Speaks to Houston Nomads. Frank Watts, director, Petroleum Administration for Defense gave Houston Nomads and their guests a brief resume of the formation of PAD, its duties and responsibilities. Guests attending the meeting were: James Ruhl, Ruhl Drilling; Carl Dillon, Republic Steel; Paul Mills, Camco Gas Lift; Marion L. Bridges; Steve Raphel, Bovaird Supply Company; Frank Watts; Orlano Camargo, Shell Oil Company, Colombia; Herbert Ladd, Stanolind Oil and Gas; Jose Martinez, Industrial Water Well Company, Mexico City, Mexico, and R. C. Marr, Bariod Sales.

Below, preparing to attach the cable head to the logging instrument. Two experimental logging instruments are in the foreground. Left, R. A. Brodeny, right, A. A. Stripling.

Components of the bore hole instrument used for magnetic induction logging. Horizontal coil in background is sensitive element. A portion of the instrument is housed in silvered thermos bottle next to coil. In foreground is bore hole amplifier. Case is standing at left.

Underground Magnetic Logging Device

Magnolia develops new aid in supplying information to map subsurface geological formations and interpret other data

The basic magnetic properties of certain types of underground formations will be used soon in a new way to aid the petroleum industry in its unremitting search for new supplies of crude oil.

Successful development of an underground magnetic measurement device by the field research laboratories, of Magnolia Petroleum Company, Dallas, Texas, an affiliate of the Socony-Vacuum Oil Company, Inc., has been announced. The technical details of the instrument were presented at the meeting of the Society of Exploration Geophysicists in St. Louis by Robert Broding.

The new method is potentially useful in supplying information that will aid in the interpretation of surface or airborne magnetometer data and in subsurface mapping of geological formations. It has potential value also in providing oil geophysicists and geologists with geological information that hitherto has been unavailable.

Designed for lowering into wells and test holes in the earth, the magnetic logging device is 4 ft long, 3 in. in diameter and weighs 80 lb. It is designed to withstand pressures of 10,000 psi and, with some of its apparatus housed in a form of thermos bottle, is unaffected by temperatures up to 250 F.

Magnolia executives said the new magnetic logging instrument is based on the knowledge that geological formations, because of their magnetic properties, will distort the earth's magnetism in such a way that, from a measurement of the distortion, it is possible to calculate the structure of the geological formations. Measurements of the distortion of the earth's magnetism is normally done with an instrument called a magnetometer, which is set up at various points on the surface of the earth and is sometimes flown in an airplane. The magnetometer has been useful in finding oil in the past in certain areas.

The new magnetic well logging instrument is expected to assist in the interpretation of the surface or airborne magnetometer measurements, as it will enable oil geophysicists and geologists to know the magnetic properties of the formations they are working with much more accurately than at present.

The new logging device is highly responsive to small amounts of iron

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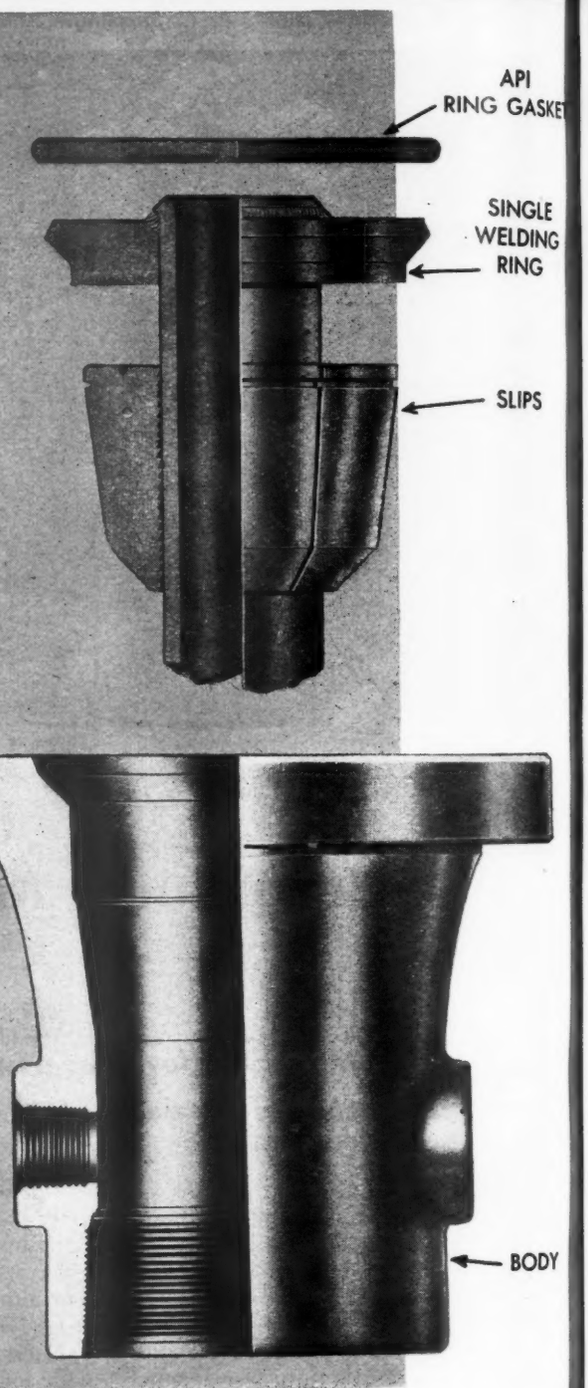

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that are often found in underground rocks and which in certain instances are of importance in recognizing different types of rock. For example, igneous rocks are often highly magnetic because of their iron content, while sedimentary rocks are normally very low in magnetism.

The new instrument not only measures the magnetic properties of the formations, but it also measures simultaneously the electrical resistance of the rock. The resistance of the rock is another property of the rock which is very important to petroleum geologists and engineers.

A particular feature of the new instrument is its ability to make measurements through a wide variety of different fluids that may be in the well at the time of measurement. Other logging methods are often inoperable in wells contaminated with large quantities of salt water or in wells that have been drilled with oil in the hole.

Magnolia officials also announced the development of a second magnetic well logging instrument by the field research laboratories in Dallas. This instrument is a saturable core magnetometer system embodying the basic principles of a "flying magnetometer," and operable throughout the length of a bore hole for measurement of the magnitude of the earth's total magnetic field as a function of bore hole depth. This "borehole magnetometer system" is yet to be built into a case that will protect it from the very high pressures found in deep wells and consequently has received only very exploratory testing compared to the first instrument.

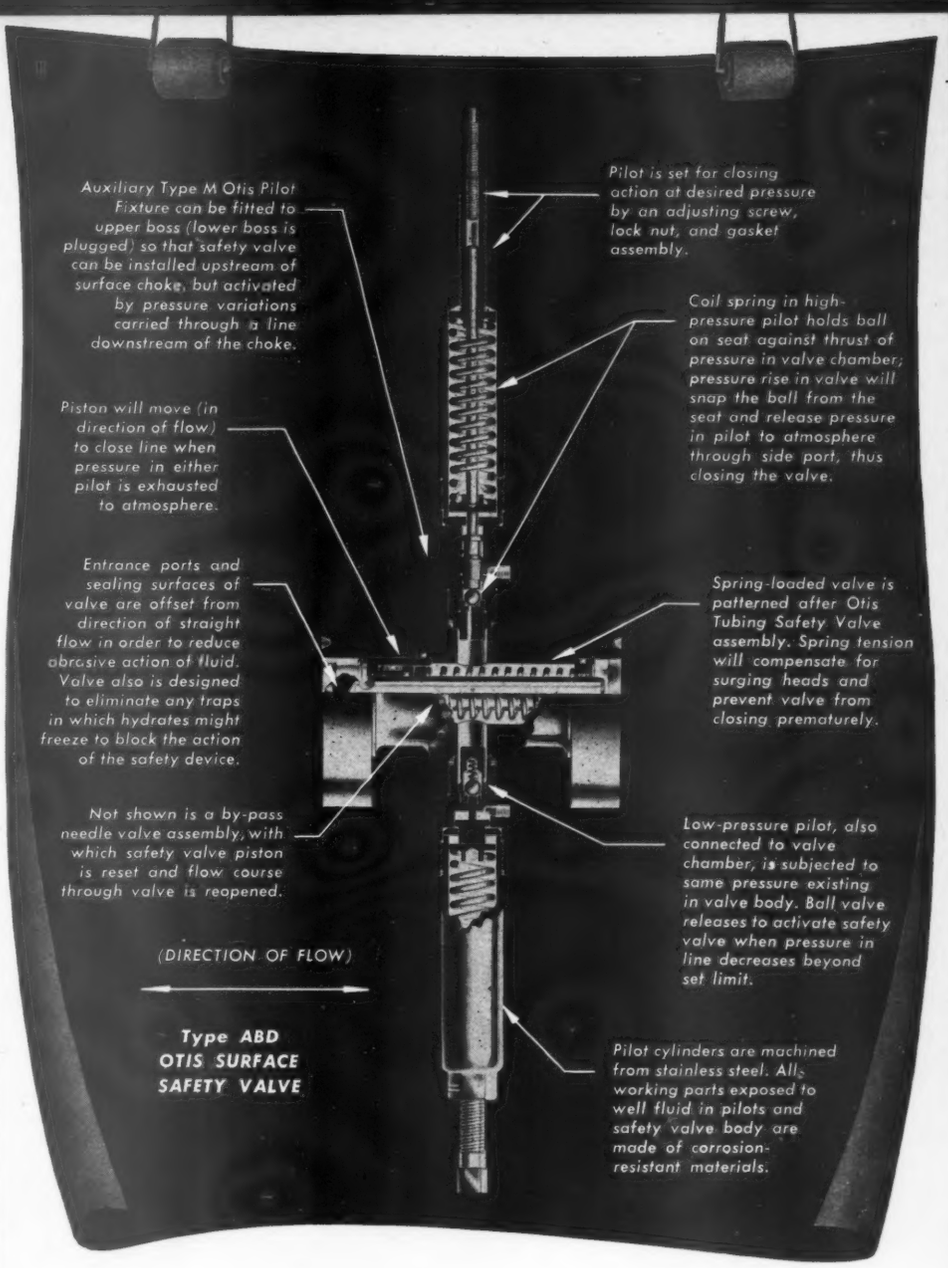
Oil States Governors Meet in Colorado

Governors of five oil producing states joined in a forum on future United States oil development during the mid-year meeting of the Independent Petroleum Association of America in Denver, Colorado, recently.

Theme of the forum was "Future Oil Empires of America." It pointed up the increasing importance of the growing oil development throughout the Rocky Mountain and Western Plains states.

Participating were Governors Allan Shivers of Texas, Norman Brunsdale of North Dakota, Dan Thornton of Colorado, E. L. Mechem of New Mexico, and Frank Barrett of Wyoming.

Governor Shivers, who is chairman of the Interstate Oil Compact Commission for conservation of oil and gas resources, presided at the forum, which he keynoted with a discussion of the benefits of conservation and orderly development of oil resources.


Auxiliary Type M Otis Pilot Fixture can be fitted to upper boss (lower boss is plugged) so that safety valve can be installed upstream of surface choke, but activated by pressure variations carried through a line downstream of the choke.
Pilot is set for closing action at desired pressure by an adjusting screw, lock nut, and gasket assembly.
Coil spring in high-pressure pilot holds ball on seat against thrust of pressure in valve chamber; pressure rise in valve will snap the ball from the seat and release pressure in pilot to atmosphere through side port, thus closing the valve.
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Entrance ports and sealing surfaces of valve are offset from direction of straight flow in order to reduce abrasive action of fluid. Valve also is designed to eliminate any traps in which hydrates might freeze to block the action of the safety device.
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Not shown is a by-pass needle valve assembly, with which safety valve piston is reset and flow course through valve is reopened.
Low-pressure pilot, also connected to valve chamber, is subjected to same pressure existing in valve body. Ball valve releases to activate safety valve when pressure in line decreases beyond set limit.
(DIRECTION OF FLOW)
Type ABD OTIS SURFACE SAFETY VALVE
Pilot cylinders are machined from stainless steel. All working parts exposed to well fluid in pilots and safety valve body are made of corrosion-resistant materials.

X-Ray of a Type A

OTIS SURFACE SAFETY VALVE

This newest Otis safety valve provides a positive means of automatically shutting off a flowing well in case of a line break, freeze-up, or other emergency condition which might cause an increase or decrease in pressure beyond safe or practical limits.

It is recommended for trees, flow wings, gathering lines, etc., where full-opening gate valves are not required. It is a self-contained, fully automatic unit that is more economical and more dependable than personal supervision of flowing wells . . . protection against fire hazards, waste of oil and gas, and damage to nearby property and equipment. Ask the Otis office nearest you about other important operating features and for technical details and illustrated literature. There's no obligation whatsoever, and afterwards you'll be better informed on the better methods of safe production.

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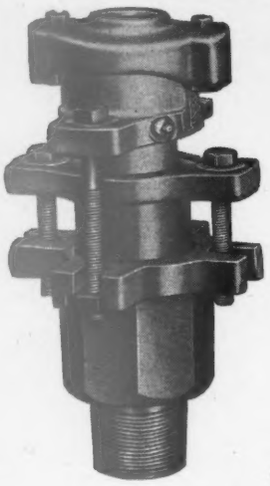

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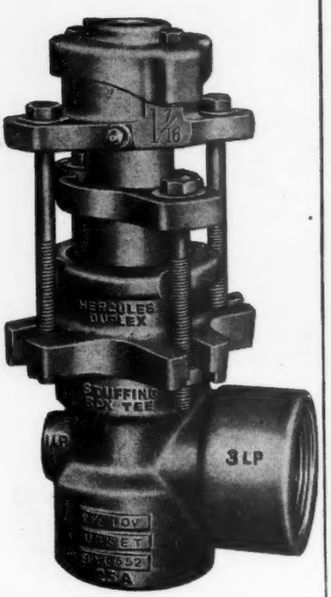

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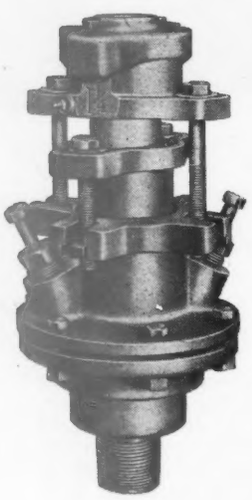

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ASME To Meet in Tulsa, Oklahoma

The American Society of Mechanical Engineers Petroleum Division will hold a petroleum conference in Tulsa, Oklahoma, September 24, 25, and 26. Four main activities are listed under the Petroleum Division—production, materials, manufacturing, and transportation. Each of these four subdivisions has a minimum of 5 papers confirmed for the September meeting. E. N. Kemler will discuss sucker rod loads and W. B. Mather, drilling in hard rock.

Geophysical Company Formed

Earle W. Johnson and Chester A. Donnally announced recently that they have jointly purchased Carr Geophysical Company and will operate the crews under the name of Donnally Geophysical Company. Headquarters for the organization will be in Dallas, Texas.

Johnson was elected president of the new company and Donnally was elected vice president. Johnson is also president of General Geophysical Company and Donnally was formerly with Western Geophysical Company. No other changes are planned in the organization, it was stated. Carr Geophysical was organized in 1944 by George Carr, who died in December, 1950. The company was operating three crews when it was purchased.

Unitization Law Upheld

The Oklahoma Supreme Court has upheld in a 5-4 decision, the constitutionality of the Oklahoma compulsory unitization law. This was an appeal from the order of the Commission unitizing the West Cement Medrano pool by Tom Palmer, one of the operators in the pool. The court ruled that this law protected correlative rights and would prevent waste by recovering additional oil.

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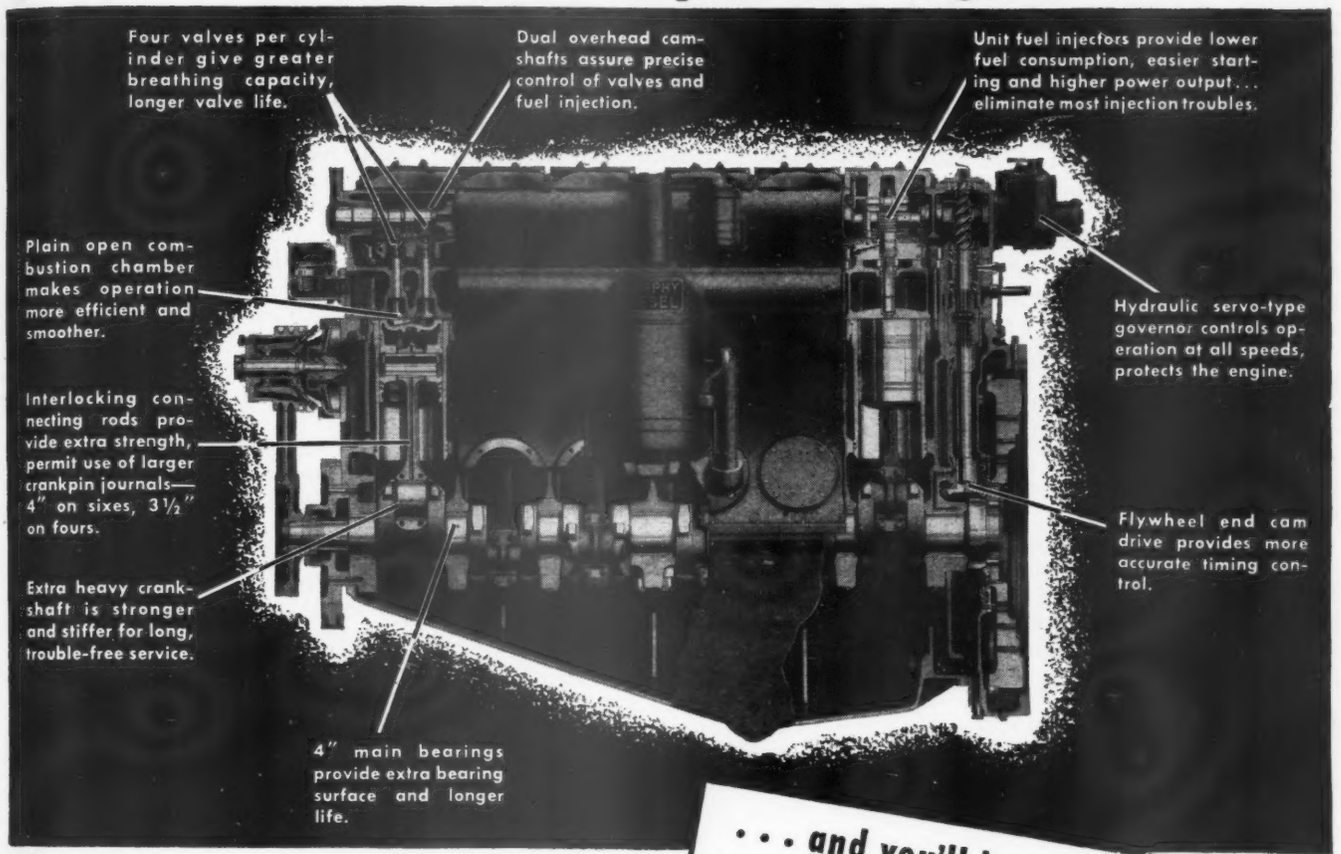
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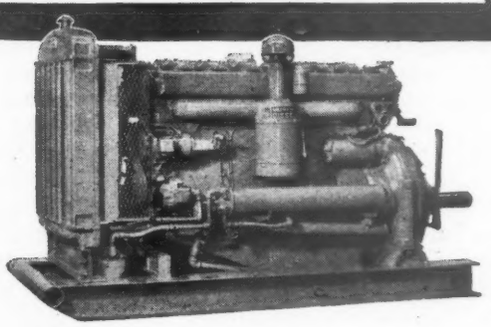

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To obtain more information on products advertised see page E-45

California Oil Men Receive Citations

Three California oil men were honored by the Pacific Coast district of the American Petroleum Institute's Division of Production for their contributions to the development of the group.

Special citations were presented to the oil men at the district's annual dinner meeting in the Biltmore Bowl, Los Angeles, California. Approximately 1200 oil and gas men from the west coast states attended the meeting.

Receiving the awards were:

Paul M. Andrews, of Signal Oil and Gas Co., Los Angeles, for service as general chairman for the 1951 meeting;

E. C. Babson, of Union Oil Company of California, Los Angeles, for service as district chairman in 1950;

C. R. Ball, of Ball and Black Supply Company, Los Angeles, for service as arrangements chairman, 1951 meeting.

Babson's citation was presented in absentia as he is on temporary leave from his firm to work with the Petroleum Administration for Defense in Washington. He is a reserves engineer for PAD.

New Test Begun in Papua

Three-fourths of a mile from the first Australasian Petroleum Company well in Papua, a new test is being drilled. The new site, which is situated at Honoro is expected to be less difficult to drill than the first test, which was abandoned at 4721 ft when all efforts to get below this depth in the heaving shale encountered had failed. In anticipation of difficult subsurface conditions, the latest advances in the technique of mud control will be employed. The company's mud engineer, N. Street, has spent recent months in Texas in the study of mud control methods now in use on the Gulf Coast. In addition APC will retain the services of O. B. Rylander, drilling superintendent in Venezuela for Socony Vacuum, as adviser until the more critical formations have been penetrated.

Completion Tests Made at Mississippi Pool Opener

Completion tests have been run at Jon Brook, Jr., and Peterson Drilling Company's No. 1 Louis Wax, discovery well for the North Lessley field of Wilkinson County, Mississippi. The well pumped at the rate of 250 bbl of 32.9 gravity oil per day with no formation water. Production is being obtained from Wilcox perforations at 7299 to 7302 ft. Hole was drilled to total depth of 8461 ft.

Calculation Method for Canadian Proration

The method of calculating the Alberta, Canada, field and individual well allowables (which were cut substantially for March from the January and February figures) for the March proration order is outlined in a release from the Western Canada Petroleum Association. It is obvious from the order that the continued development of proved fields will automatically result in continued cutting of the allowables for those fields, with consequently greater hardship on recently completed wells than on the older producers. This is the calculation method:

Nominations for the month are placed by the purchasers of crude, in terms of barrels per day per field group, Leduc and Redwater constituting the principal individual fields but both grouped with several small pools. The group total is then allocated to individual fields by splitting it in relation to the previous month's proration order. This gives the rough pool nomination.

The number of wells capable of production as at the first of the preceding month is taken and weighted by the addition of estimated completions to the middle of the current month. The total is used in all further calculations. The "pool economic allowance" is calculated by taking the economic allowance factor from the Petroleum and Natural Gas Conservation Board's chart and multiplying it by the number of wells in the pool. Pool potential is then calculated by multiplying the pool MPR (maximum production rate) per well by the number of wells in the pool. A correction factor is added here, based on the previous month's pool performance, taking into account such items as gas-oil ratios, water penalties and inability of individual wells to make their production allowable. The correction factors have been running to less than one per cent.

Residual demand is calculated next, as the difference between total nominations and the total pool potentials or economic allowance, whichever is less. For March, the report shows, residual demand was only 4000 bbl per day, which is divided among the three classifications of heavy, intermediate, and light and allocated in these classifications to each pool on the basis of its adjusted pool MPR. The final pool allowable is thus the total of the economic allowable and the pool share of residual demand. The final pool allowable is then allocated among the wells in the pool on an equal basis, by dividing by the total number of wells.

As a final adjustment, the individual well production is given the benefit of the reciprocal of the previous correction factor so that the proration figure will represent an increased allowance to the good wells to balance expected deficiency of the poor wells, thus insuring the full proration allowable being produced by the whole field.

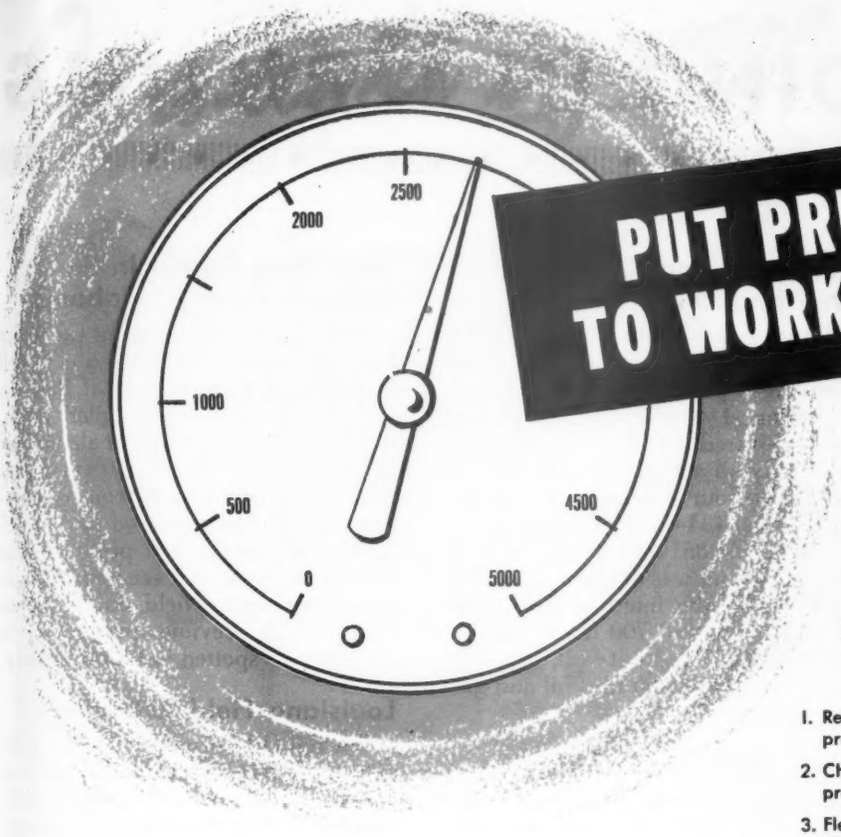
The extensive safety program sponsored initially by three drilling contractors in Calgary received such a warm reception at the first quarterly meeting of the Canadian Association of Oilwell Drilling Contractors that it seems likely to be headed for a permanent place in contractors' overhead. Analysis of the current short-term plan which has been in effect for only nine months showed apparent saving in accident costs amounting to a great deal more than the cost of the program.

The first half of the program of supervisory training, under direction of the University of Alberta, occupied the period from May to October 1950 and served 17 rigs scattered throughout the province. Cost was about $325 per month for salaries and travelling expenses. The second half has been confined to 12 rigs and has to run to the end of May 1951. The cost of this half is about $600 per month. According to Allison Mitchell, director of supervisory training, the greatest problem is the lack of experience of most new crew members and the necessity of rapid promotion to supervisory positions before they have become thoroughly familiar with the machinery and equipment.

The safety education part of the program has been developed by training the supervisory employees in methods of instruction, then showing them by example, right at the rigs, how incentive can be created to induce men to work with more care and more intelligently. Workmen's Compensation Board figures for the two companies most active in the program have shown a decided improvement in their accident rates.

Alberta Gas Reservation Brings Record Price

George F. Chadburn, land man for Seaboard Oil Company of Delaware, paid the highest price ever paid for a petroleum and natural gas reservation in the Alberta province, the Alberta government reported recently. Chadburn paid $506,492 for 11,174 acres of land in the Bittern Lake area, west of Wetaskiwain in Northern Alberta. He reserved the land for geological or geophysical examination or for drilling of wells for geological information.



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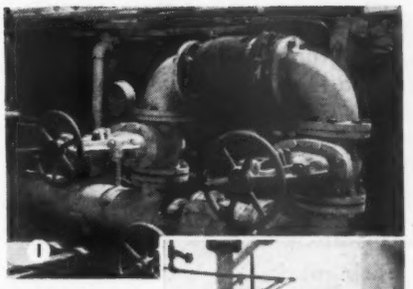
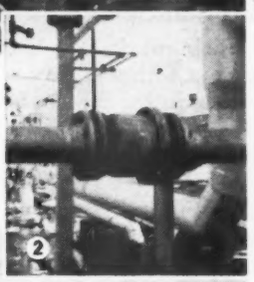
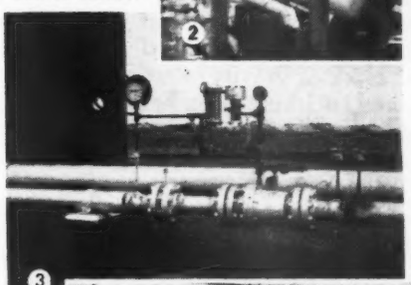




1. Reliever holding back pressure on gas line.
2. Chexflo in gas compressor discharge line.
3. Flexflo automatic shut-off in gas line to heater.



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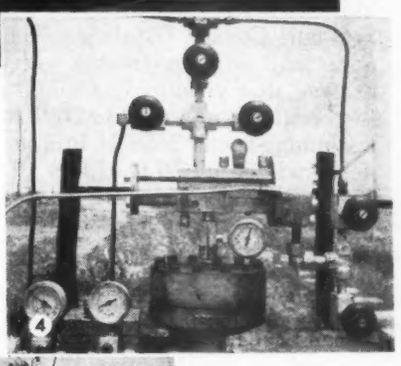
The "O" ring Seat-Seal principle, embodied in "T" and "V" series globe-type valves and "F" and "M" series slide valves, has greatly increased the field of usefulness and the pressure ranges of these valve types.

The products illustrated are only a few examples of the flexibility and adaptability of all these exclusive Grove developments. For your control problems, too, Grove can provide regulators and valves of unequalled reliability. Contact the nearest Grove office today, or address your inquiry to:



4. Well Head Protection System, T-series Seat-Seal Valves in manifold.
5. Model 899 Separator Oil Valve.

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WHAT'S DOING IN DRILLING

Nebraska Sector Scene Of Rapid Oil Development

The Nebraska section of the Denver-Julesburg basin is scene of the fastest development in the West. Two oil and one gas fields have been discovered there this year, and today the average production is 9650 bbl. A year ago Nebraska was producing 1500 bbl of oil a day. In the western part of the state, 31 oil wells, 1 gas well, and 13 dry holes have been completed in the first 4 months of 1951.

Continental Opens New Zone

Continental Oil Company has opened a fifth and deeper oil producing zone in the Sussex block in north central Wyoming with its Sussex A-59 well. On drill stem test from 9115 ft, at the top of the saturation, to 9129 ft in the Tensleep sand, the well showed gas in 45 min and flowed oil in 50 min. The tester was pulled and 9100 ft of black 32-gravity sweet oil was recovered, marking first Tensleep production in the field or vicinity.

New Zone Discovery In Oklahoma Field

The No. 1 Reed drilled by W. B. Moran is a new zone discovery well in Seminole County, Oklahoma. The Senora sand is being treated with Hydrafrac after yielding free oil on drill stem test. The well went to 2891 ft after running test at 2656-71 ft in the Senora and getting 20 ft of free oil and 35 ft of heavily oil-cut mud. Casing was set at 2700 ft before production testing began.

New Canadian Well

Canadian Gulf Oil Company has a new well in the Devonian D2 zone in the northern sector of Stettler oil field, about ¾ mile from previous production. Prior to reaching the Devonian, the oil well, Gulf-Skow 15, found moderate flows of natural gas in the Viking and basal quartz formations. The D2 zone of Devonian was oil bearing, but D3 horizon was water-loaded.

Pennsylvania Gas Field

New York State Natural Gas Corporation has completed its N-192 Elizabeth Daugherty et al in Leidy township, Clinton County, Pennsylvania. The well gaged 3,800,000 cu ft of gas. The Onondaga was topped at 5878 ft.

Wyoming Pool Extended One and One-Half Miles

Phillips Petroleum Company's No. 11 Cole Creek has extended the South Cole Creek pool in Converse County, Wyoming, 1½ miles northwest. The well recovered 225 ft of oil and 90 ft of heavily oil and gas-cut mud following a 1½-hour drill stem test of the Lakota at 8434-62 ft. Total depth of the well was 8514 ft, where 16 ft of saturated sand was uncovered. A drill stem test of the interval, 8457 ft to 8540 ft, recovered 700 ft of fluid, being 360 ft of 31-gravity oil, 180 ft of mud-cut oil, and 160 ft of oil and gas-cut mud.

Shell Well Successful

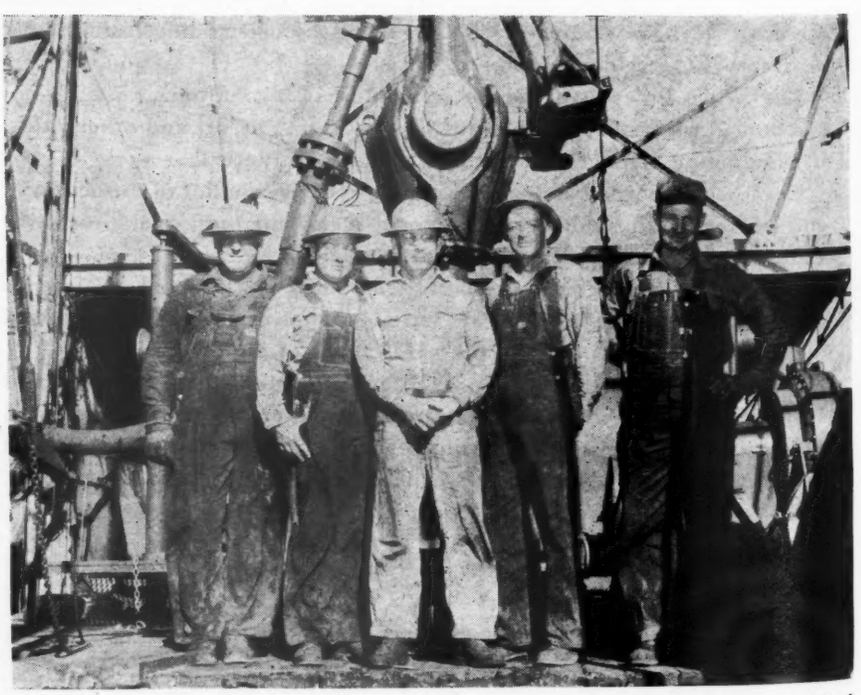
Beckham County, Oklahoma is the scene of a Shell Oil Company producer, its No. 2 Hutton. Plugged back depth of the new well is 10,058 ft, and it flowed 451 bbl of 53.8 gravity oil and 37 bbl of acid water in 24 hours through a 22/64-in. choke. Gas-oil ratio was 1385 to 1. Production is through perforations between 9565-85 ft and between 9530-50 ft.

New Well Drilled In Baldwin County, Alabama

Humble Oil and Refining Company has successfully completed a new well in the South Carlton field of Baldwin County, Alabama. On completion test, the No. 1 Charles Oswell et al, pumped at the rate of 70 bbl of 13.6 gravity oil per day. Production is from perforations in the Massive sand at 5417-25 ft. This marks the first production in Baldwin County, and succeeds in making a two-county field out of South Carlton. All previous production in the field was spotted in Clarke County.

Louisiana Field Extended

Warren Oil Corporation's No. 1 Elmer E. Jeffers has extended oil production ½ mile east at Crowley field, Acadia Parish, Louisiana. Through perforations at 9819-24 ft in the Baronet zone, the well flowed 453 bbl of 38 gravity oil daily. Hole is bottomed at 11,260 ft and operator set 7-in. casing at 10,457 ft. Gas-oil ratio is 686 to 1. The well has been given an allowable to 27 bbl daily. It extends South Crowley field a half mile east.



Operates Steam Rig. One of the three crews that operate the controlled steam rig* for Little Nick Oil Company of Chickasha, Oklahoma: (left to right) M. E. Collins, derrick man; J. H. Hammonds, roughneck; John Baker, driller; A. D. Ambrose, roughneck; and E. M. White, roughneck.

*The "Titan Steamair" rig manufactured by Wilson Manufacturing Company, Wichita Falls, Texas.

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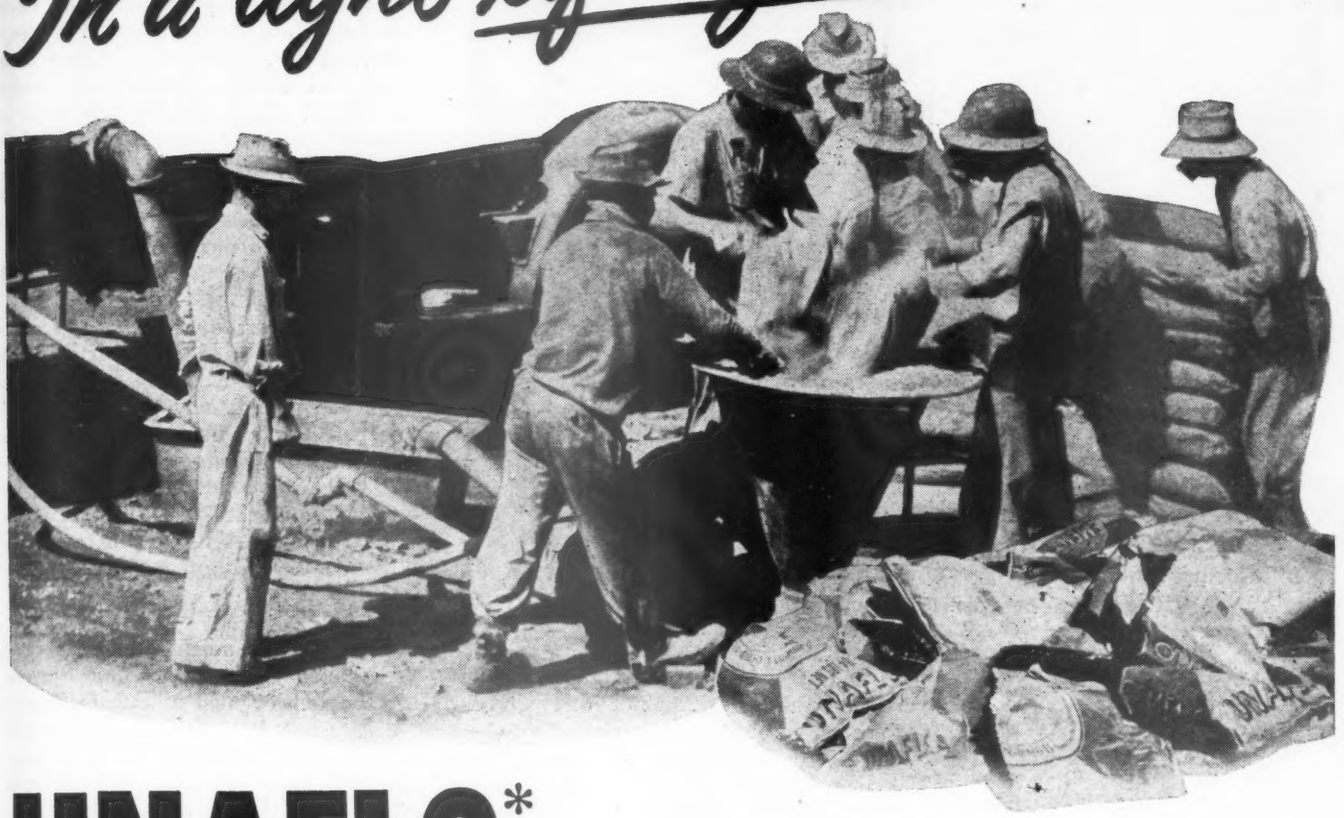

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NBC SUMMER SYMPHONY CONCERTS—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—June to September*

AAODC Safety Clinic. More than 220 representatives of drilling firms attended the American Association of Oil Well Drilling Contractors' annual safety clinic in Dallas, Texas, recently. Some of the delegates from Canada were: David Gunderson, Regent Drilling Company; D. L. Cuthbert, Imperial Oil, Ltd.; H. R. Hess, Parker Drilling of Canada; A. L. Grainger, McIvor Drilling of Canada; J. L. Muir, General Petroleums of Canada, Ltd.; G. C. Cochran, Workmen's Compensation Board; N. W. Goerz, and D. Harris, Can-Tex Drilling, Ltd., and J. Adam, Commonwealth Drilling Company, Ltd.

New Producer Added to Hub Field, Mississippi

Hub field of Marion County, Mississippi is the scene of a good producer, drilled by Humble Oil and Refining Company. The company's No. B-1 W. E. Walker was completed flowing through 1/8-in. choke at the rate of 209 bbl of pipe line oil per day. Gas-oil ratio was 960 to 1. Tubing pressure was 1950 lb. Production is being obtained from the perforated interval at 9138-40 ft.

Reef Trend Established

General Crude Oil Company has apparently established the reef trend around its new well the No. 1-6 Jones, which is an offset to Kewanne Oil Company's No. 1 Oliver, recent Kent County, Texas, discovery or major extension in the Salt Creek area. The Canyon reef was hit at 6275 ft, minus 4126 ft. It is drilling ahead with no tests reported to date.

Two-State Field Set For Texas, Louisiana

A two-state field is in the making in Louisiana at Stanolind Oil and Gas Company's No. 1 Pine Woods Lumber Company, Columbia County. The test is a 1-mile north outpost to North Shongaloo field in Webster Parish. The well flowed at a 20-bbl per hour rate, settling down to 9 bbl per hour.

New Zone in Texas Field

Ohio Oil Company's No. 2-A Anderson in Stonewall County, Texas is scene of a second new pay zone in the Frankirk Ellenburger field. A drill stem test in the reef from 5011-65 ft had gas in 8 minutes and flowing oil in 62 minutes. It was flowed into pits at an estimated rate of 10 bbl an hour. Operators were pulling pipe at last report.

Stanolind Completes Well In Oklahoma Field

Stanolind Oil and Gas Company's No. 2 Kolb in the North Milroy pool of Stephens County, Oklahoma has been completed for a flow of 102 bbl of oil in three hours through a 1-in. choke from perforations at plugged back depth of 4000 ft. Drilled to 5886 ft, it plugged back first to 5855 ft and has a good blow of gas just above that plugged back depth. Oil production is from the Deese sand and gas was found in the Springer.

Shell Drills Gas Well In Louisiana Parish

A gas-distillate discovery has been completed by Shell Oil Company at its No. 1 State Lease 1593 in Atchafalaya Bay of St. Mary Parish, Louisiana. The new well was bottomed at 14,697 ft and plugged back to 11,697 ft for testing. Completion was from perforations at 9534-42 ft. On final tests the well flowed at the rate of 34 bbl of 51.5 gravity distillate and 1,309,000 cu ft of gas per day through 10/64-in. choke. Early perforations in the well at 11,447-52 ft were squeezed following recovery of a large percentage of salt water. Tubing pressure was 3250 lb on completion tests, however, at the time the well was shut in, pressure had risen to 3550 lb.

New Depth Record Made In Texas Gulf Coast Well

Meredith, Clegg, and Hunt have broken their own record for deep drilling in the Texas Gulf Coast area with completion of their No. 1 Weisse at 12,631-12,725 ft. The new well is situated in West Hamshire field, Jefferson County, Texas. It flowed 20,000,000 cu ft of gas per day plus 59 bbl of condensate per million cubic feet of gas through 380 jet perforations. The hole was drilled to total depth of 13,353 ft.

Prior to drilling of this well, the No. 1 Earl C. Hankamer, drilled last year as the discovery well for the West Hamshire field, held the title as the deepest Texas Gulf Coast well. It was completed from open hole at 12,607-70 ft. On open-flow gage, the discovery well made 125,000,000 cu ft of gas daily, plus 53.4 bbl of 51.6 gravity distillate per million cubic feet of gas.

Mississippi Well Complete

Union Producing Company has completed its No. 29 Jennie Stevens in the Tinsley field of Yazoo County, Mississippi. It is pumping at the rate of 184 bbl of 37.8 gravity oil per day, and has been bottomed at total depth of 5428 ft. Completion is from perforations opposite the Stevens sand at 4844-55 ft.

Beckham, Oklahoma Well Is Large Producer

A new Beckham County, Oklahoma well is flowing 1532 bbl of 42 gravity oil in 24 hours. It is the United Carbon Company No. 1 C. R. Eiel, which is producing through perforations between 10,506-18 ft through 23/64-in. choke. With the oil, 645,000 cu ft of gas per day is flowing.

Superior Will Deepen Well For Testing at 20,000 Ft

Superior Oil Company has reported a 20,000-ft test planned for its prolific Portilla field, San Patricio County, Texas. The company's No. 27 Minnie S. Welder will be deepened to 20,000 ft, making it the deepest test drilled in Texas. The well is now bottomed at 13,785 ft with 9⅝-in. casing cemented at 9090 ft.

Superior Well Successful

Katie pool of Garvin County, Oklahoma has a new well. It is Superior Oil Company's No. 1 Conrad-Stevenson, which was completed at a depth of 7075 ft. Drilled to 7075 ft where 7-in. casing was cemented, the well was perforated to flow 438.66 bbl of oil in 15½ hours through a 24/64-in. choke, and showed a gas-oil ratio of 800-to-1 with the 41 gravity crude.

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EXPLORATION ACTIVITIES

Italy Reports Twelve Geophysical Crews at Work

Signor Enrico Mattei, vice chairman of Azienda Generale Italiana Petroli, has reported to the Italian parliament that his company now has 12 geophysical parties at work in Lombardy, Piedmont, Emilia, Venetia, Marche, Puglia, and Lucania. These parties have already located about 10 oil and gas structures in the Po Valley whose detailed exploitation is to begin shortly, Mattei stated. He added that a very satisfactory result has been obtained in the zone of Cornegliano near Lodi. In the four main fields, there are 50 wells that could produce 6,000,000 cu metres of methane daily were there a market for such an output of natural gas.

New Chilean Gas Well

Empresa Nacional del Petroleo has discovered gas production on the mainland of Chile. The new well is across the Straits of Magellan from the company's existing Cerro Manantiales oil field. The well is reported to have gone to about 7500 ft, and encountered some 60 ft of sand, obtaining a consistent blow of wet gas. ENAP is preparing to commence another well on a location lower on the structure.

Carter Well Opens New Oklahoma Field

Carter Oil Company et al No. 1 Garrett in Beckham County, Oklahoma, is a prospective pool opener. The new well is swabbing 40 gravity oil on test. It flowed 22 bbl of oil by heads in 12 hours and then swabbed 35 bbl of oil in 8 hours. During the first hour of the 8-hour test the well swabbed 5 bbl of oil, 10 bbl in the second hour, and 10 bbl during the final 5 hours of the period. A severe rain and wind storm was thought to be responsible for the reduced output in the last 5 hours of the test.

West Texas Wildcat Drilled

A new Devonian-Silurian producing formation discovery well in Dawson County, Texas was completed recently by Amerada Petroleum Corporation. The well is the No. 1 D. L. Adcock, which flowed 662 bbl of oil in 18 hours through a ½-in. tubing choke, with perforations in the casing from 10,605 to 10,615 ft, after acidizing with 500 gal.

First Wildcat Goes Down in East Pakistan

The oil quest in the Patharia hills began recently when the governor of East Pakistan, Malik Feroze Khan Noon, performed the spudding in ceremony of the first test well of Pakistan's first oil company—Pakistan Petroleum Limited. Standing at the controls the governor himself drilled the first foot of hole. Speaking on the occasion Malik Feroze Khan Noon gave a brief survey of the efforts of the Burmah Oil Company to tap the oil resources of the Patharia hill tracts since 1917 when the Government of Undivided India granted the concern a prospecting license. He said that when he took over as Governor of East Pakistan he had negotiated with the Burmah Oil Company in Pakistan for the resumption of oil prospecting in the Patharia forests and added that the Government of Pakistan had decided to grant the mining lease to Pakistan Petroleum Ltd., an offshoot of the Burmah Oil Company, in view of the experience of this company in the field of oil exploration.

He emphasized that while Pakistan possessed vast unexplored resources and monetary reserves she lacked technical experience and expressed his appreciation of the remarkable speed with which Pakistan Petroleum had rigged up their drilling equipment in the Patharia forests and complimented the manager and his staff on their efforts to expedite the drilling operations here.

Malik Feroze Khan declared that Pakistan was an Islamic state whose laws would be based on the "Shariat." He called upon the workers to read the Quaran and understand the spirit of Islam.

He disclosed that about 2000 copies of the English translation of the Quaran had been acquired in Lahore which would soon reach East Pakistan and copies of the Bengali translation of the Quaran would also be available shortly. He was confident that if the workers read the Quaran every morning it was possible that oil might be found here in two months instead of the four months stipulated for drilling.

The manager of the prospecting company, M. J. Condon, while welcoming Malik Feroze Khan Noon said that the drilling operations in Patharia were being undertaken by Pakistan's first petroleum company—Pakistan Petroleum Ltd. He added that though the company had been granted the mining lease only in the middle of 1950, it had been able to undertake the operations in a few months' time.

Condon said that the Burmah Oil Company had in the past drilled two wells in the Patharia region, one of which produced some oil while the other proved a dry hole. He was glad that the settlement of the boundary dispute had enabled the resumption of the prospecting operations. The new well was being drilled in the hope that it would produce oil though it could not be predicted that oil would be found. He appreciated the services of the employees and thanked the local administration for its cooperation in the renewal of the operations.

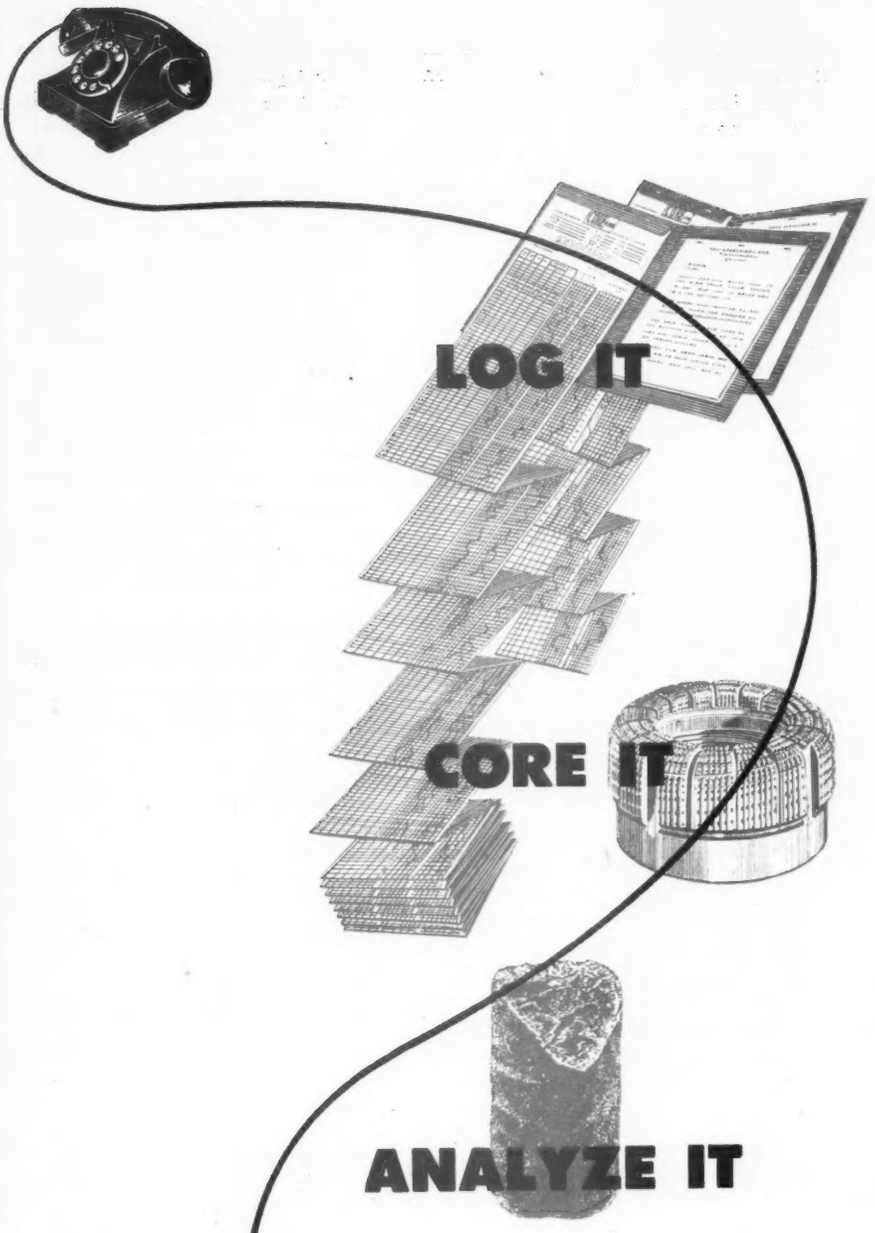
"The importance of oil," he added, "in these modern days of industrialization is of course very great and many interests are therefore involved in this venture. We are proud that our own interests should be so completely identified with those of Pakistan and particularly East Pakistan."

First Producer Seen For New Mexico County

An important major discovery seems apparent for Roosevelt County, New Mexico, at the Magnolia Petroleum Company's J. B. Brown No. 1. The new well flowed 112 bbl of 45 gravity oil into tanks in 2 hours on a drill-stem test of Pennsylvania between 8008-8142 ft. In addition 1,500,000 cu ft of gas per day were recovered. If successfully completed, the well will be Roosevelt County's first oil producer.

Oil Field Indicated For California Area

A new oil field is apparent in the Cuyama Valley of California, with discovery of Richfield Oil Corporation's and Seaboard Oil Company's joint Kirschenmann wildcat. The well is producing on the pump more than 200 bbl daily of 44 gravity oil from a depth of 7300 ft. Richfield's president, Frank Morgan, reported that until further testing the capacity or value of the new field cannot be estimated.



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South Dakota Land Brings State's Highest Lease Bid

High bid was $6 per acre for oil and gas lease on a large spread of acreage in South Dakota recently. The land, leased by M. B. Rudman of Dallas, Texas, was leased by the school and public lands commission of that state. Bernard Lind, commissioner of lands, reported that this is the highest prices ever paid for oil and gas leases in South Dakota. Rudman and E. F. White, Jr., also of Dallas, did much of the blocking in the western part of North Dakota where Amerada Petroleum Company opened production.

Indiana Oil Field Seen

A new oil producing area opener is indicated for Indiana at the T. and H. Corporation Robert Lowery and Charles Able No. 1 Bettenbrock in Vigo County. The Devonian limestone will be tested at 1625 to 1628 ft, and 1635 to 1664 ft. Total depth is 1653. No drillstem test had been run at last report.

New Discovery Made In West Texas Area

Standard Oil Company of Texas has made a new oil discovery in the North Snyder area of Scurry County, Texas. The Parks No. 19 was completed from Cisco sand in open hole from the interval 6120-6202 ft. On official potential test, the well flowed 209 bbl of clean oil in 24 hours through 17/64-in. choke with a flowing pressure of 225 psi and a gas-oil ratio of 590. The gravity of the crude is 41.5 deg.

Aramco Wildcat Opens Saudi Arabian Field

Oil has been discovered in a wildcat well in Saudi Arabia, it was announced by W. F. Moore, president of the Arabian American Oil Company. The new location is at Ithmaniya, approximately 40 miles south of the Ain Dar field discovered in 1949 and 20 miles west of the city of Hofur. The oil is sour and was found at depths comparable to other producing fields in Aramco's concession area. Extent of the new field is unknown.

Kansas Wildcat Successful

Cities Service Oil Company (Delaware), has completed a wildcat strike in Gove County, Kansas, for an initial of 3000 bbl of oil daily.

The company's Coberly No. 1, situated about 25 miles southeast of Oakley, is producing from perforations in the Marmaton limestone from 4287 to 4298 ft. In a test of the lower Marmaton limestone, 4303 to 4310 ft the well pumped 130 bbl of oil in 8 hours. Nearest commercial production is the small Arnold pool, 25 miles to the southeast.

Cities Service Stake Montana Wildcat

A rank wildcat for Sweet Grass County, Montana, has been reported by Cities Service Oil Company (Delaware). The 7500-ft test is the Cremer Rodeo, Land and Livestock No. 1, in the center. Principal objectives of the test have been indicated as the Eagle Frontier, Cat Creek, Ellis, Amsden, Kibbey, and Madison formations.

Union to Search for Oil In Costa Rican Provinces

Union Oil Company of California and the Government of Costa Rica have signed a contract giving Union Oil the exclusive right to search for oil and gas in the provinces of Limon and Guanacaste, Costa Rica, Reese H. Taylor, President of Union Oil, announced.

"The contract, which must be ratified by the Costa Rican Congress, is a fair and reciprocal document providing maximum safeguards and guarantees to both parties. It was signed for the Government of Costa Rica by President Otilio Ulate and Minister of Industry Volio Guardia. Both the president and Minister of Industry have publicly stated their complete satisfaction with the fairness of the contract and the opportunity it provides for the exploration of Costa Rica's oil possibilities," Taylor said.

Natural Gas Found At Canadian Wildcat

The California Standard Company has struck natural gas plus oil at a wildcat in central Alberta, Canada at its wildcat 22 miles northwest of the Stettler Devonian oil field. The discovery well, the California Standard-Spotted Lake No. 4-21, is situated in the top portion of D3 Devonian zone, where gas is flowing at rates between 4 and 6,000,000 cu ft daily.

First Marine Well Drilled in Trinidad

Within 22 days of the beginning of the first marine well in Trinidad, an initial yield of 150 bbl per day has been brought in at 3300 ft under the sea off Guapo on the south coast of the island, it was reported from the Port of Spain. The well is said to be an inclined one, sunk from a point 50 yards inland between the Pitch Lake and United British Oilfield's refinery at Point Fortin.

New Frio Discovery Made

Niloco Company and Bel Oil Corporation have an oil flow estimated at 50 bbl per day through 5/64-in. choke at its new Frio discovery in Allen Parish, Louisiana. The No. 1 J. A. Bell flowed from the perforated interval at 5888-90 ft. Tubing pressure was 925 lb. Total depth was 7510 ft.

Oil Creek Sand Well

L. O. McMillan, Dallas, Texas, has completed his No. 1 O. B. Rich, R. H. Armstrong survey, in Grayson County, Texas, for 415 bbl daily through 3/6-in. choke. Production is coming from 8233-35, and gas oil ratio is 1440 to 1. It is a mile from a field.

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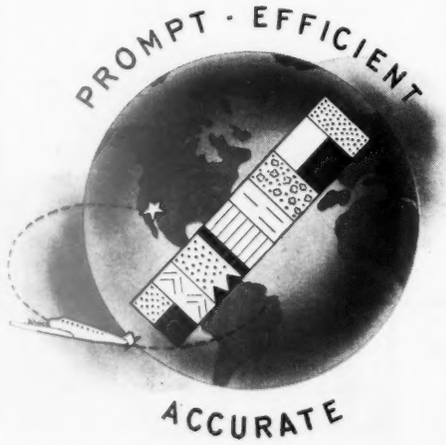

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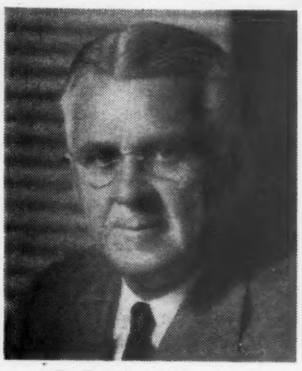

R. D. Montgomery

P. B. Leavenworth

Mark Olson

▸ **Richard D. Montgomery,** manager of the exploitation department of Richfield Oil Corporation since 1937, was elected a vice president of the corporation. As vice president in charge of exploitation, Montgomery directs Richfield's drilling, production, and gas department operations. A veteran of more than 35 years in the oil industry, he has been associated with Richfield since 1926, when he became head of the land department. In 1931, he took charge of production, land, and engineering, continuing in that post until he became manager of the exploitation department. Montgomery was graduated from the University of California in 1911.

▸ **V. H. King** has been appointed to the newly created position of manager of General Petroleum Corporation's exploration department. Formerly supervisor of exploration in the Rocky Mountain district, his headquarters will be in the company's home office in Los Angeles.

K. A. Gorton, former assistant supervisor of exploration in the Rocky Mountain district, will replace King as supervisor of exploration, Rocky Mountain division.

K. A. van der Weg and **P. H. Gardett** have been promoted to positions in Los Angeles. Van der Weg advances to the post of supervisor of geophysics, Los Angeles, from the same position in the Rocky Mountain division, at Casper, Wyoming. He replaces **N. R. Shade,** who has retired. Gardett is the new assistant supervisor of exploration, California division.

A. G. Alpha advances from district geologist, Montana, to regional geologist, with offices in Casper, Wyoming. **F. R. Reeves** takes over the position of geophysicist, Rocky Mountain division. Reeves, a new employee, came to General Petroleum from the Western Geophysical Company, and will make his headquarters in Casper.

R. A. Howe advances to district geologist, Northwest Colorado, from his previous position as assistant geologist, and will continue to make his headquarters in Craig, Colorado.

J. E. Keenan has been transferred to Billings, Montana headquarters as district geologist, Montana. He formerly held the same position in Northwest Colorado and Western Wyoming.

J. H. Casey, district geologist, has been transferred from the East Wyoming area to the same position in the Santa Maria district (California).

▸ **Paul B. Leavenworth** recently joined the Housh Drilling Company. Leavenworth was formerly chief geologist for the Houston district of the Gulf Oil Corporation, and had completed 35 years service with that company. His offices will be at 586 Gulf Building Addition, Houston.

▸ **V. A. Peterson** has been appointed division geologist for the central division, Sinclair Oil and Gas Company, with headquarters in Tulsa, Oklahoma. Peterson joined Sinclair in 1948 as division seismologist in the Denver, Colorado, division. He is a graduate of the Colorado School of Mines, and was formerly employed by Sun Oil Company, Cities Service Oil Company, and Atlantic Refining Company.

▸ **Jack L. Roach** was appointed manager of the land and exploration service department. Roach has had 12 years of experience in geological and drafting work for the Pure Oil Company in Tulsa. He obtained his BS in geology at the University of Tulsa in 1948.

▸ **Frank T. Clark** of Fort Worth has been appointed chief geologist for Cities Service Oil Company (Delaware). The announcement also reports the appointment of **Frank Cooter,** Fort Worth to the new position of exploration field division manager at Fort Worth. Clark joined the company in 1924, as Kansas division geologist. In 1948, he was named division geologist in the Fort Worth office. Clark received his BS degree in geology from the University of Oklahoma.

Cooter served as division landman for Cities Service at Fort Worth for three years. He was first employed by Cities Service as a landman in 1928.

▸ **Mark Olson** has accepted the position of general manager of operations for C. J. Brown, independent oil operator at Houston, Texas. Starting out as a roughneck in the oil fields, Olson went on to graduate from the New Mexico School of Mines in 1942 as a petroleum engineer. Following graduation he joined Stanolind Oil and Gas Company in West Texas as an apprentice engineer and subsequently went into drilling and production work for the same company throughout Texas and parts of Oklahoma. He joined *World Oil* magazine as international editor in 1950—the position he leaves for his latest appointment.

▸ **Charles A. Perlitz, Jr.,** vice president and regional manager for Continental Oil Company, Houston, Texas, was guest speaker at the April meeting of the Petroleum Engineering Club, student affiliate of AIME at Texas A. & M. College. He was accompanied by Orville Fisher, assistant regional manager for Continental at Houston.

▸ **A. E. Dietert** of Bartlesville, Oklahoma, has been named as division geologist for Cities Service Oil Company (Delaware) at Fort Worth. **Norman W. Ewbank** will assume Dietert's duties in the Bartlesville geological offices.

Dietert joined Cities Service in 1929, when he was employed as scout for the company at Seguin, Texas. In 1941 he was appointed division geologist in Bartlesville for Texas. He was graduated from the University of Texas with a BA degree in geology.

Ewbank, who replaces Dietert at Bartlesville, was employed by Cities Service in May, 1948. He was graduated from the University of Texas with a BS degree in geology.

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2. **A conical bullet has a tendency to skid.**

In the beginning, conical shaped bullets were used almost exclusively in all gun perforators. In an attempt to minimize the burr, the ogival (an arc coming to a point) bullet was developed. Today, this type of bullet is used in most gun perforators. However, there are three disadvantages in using an ogival shaped bullet:

1. **It still leaves a large burr, although the jagged edges are bent over. Due to this burr a casing scraper must be used before running close fitting tools, such as: packers, testers, bridging plugs, swabs, etc., to prevent damage to these tools.**
2. **The bullet still has a tendency to skid.**
3. **The shape of the bullet tends to diminish penetration.**

Development of the Burrless Bullet

Several years ago an attempt was made by several service companies to develop a burrless bullet. Although burrless bullets were developed, the diminishment in penetration was so great that they were valueless.

The McCullough Tool Company, however, continued its research. A true burrless bullet was developed that not only eliminated the burr but actually increased penetration. These burrless bullets have been standard equipment on all McCullough Gun Perforating jobs for several years.

Advantages of the McCullough Burrless Bullet are:

1. **No burr is left on the inside of the casing, eliminating the need of casing scrapers after the perforating job.**
2. **Increased penetration.**
3. **Cannot skid.**

The burr and tendency to skid is completely eliminated by the addition of an ogival shaped alloy jacket on the bullet itself. Shape of the bullet under the jacket is conical. When fired, the alloy jacket is consumed in the first string. Thereafter, the deepest penetrating bullet known—the conical bullet—penetrates additional strings, the cement sheath, and deeper into the formation.

Can Only Be Used In McCullough Gun Perforator

Due to the design of the McCullough Gun Perforator, it is the only gun that can use this type of bullet. The seal in the McCullough Gun Perforator is behind the bullet, in other guns—in front of the bullet. Therefore, if used in other types of gun perforators, the alloy jacket would be lost while leaving the gun body. Most sizes of McCullough Gun Perforators use all five sizes of burrless bullets—¼", ⅜", ½", ⅝", and ¾". Special sizes are also available to meet specific needs.

When ordering gun perforating service, customers invariably specify burrless bullets, although they know we also have standard ogival bullets available.

Write for this Catalog

The new McCullough section of the Composite Catalog is now ready. Pages 3209 to 3220 are devoted to the McCullough Gun Perforator. Page 3217 describes the Burrless Bullet and a 7,188 hole perforating job completed in only 65 hours. Write to the McCullough Tool Company for your copy.

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To obtain more information on products advertised see page E-45

▸ **R. R. Anderson,** formerly of Sun Oil Company's Morganfield, Kentucky, production district, has been named assistant to the manager of the Michigan division land department, with offices in Toledo, Ohio. He is succeeded at Morganfield by **R. E. Dobkins. N. E. Anderson** has been appointed to the newly-created post of assistant office manager of Sun Oil Company's Dallas, Texas, office. **Harvey J. Muntzel** has been named cashier at Dallas.

▸ **Henry L. Waszkowski** was made assistant district superintendent of Magnolia Petroleum Company's Healdton, Oklahoma producing district. He has been division petroleum engineer at division offices for the state of Oklahoma, Oklahoma City.

▸ **B. L. Jones,** Humble Oil and Refining Company, assistant district superintendent of Talco district, East Texas division, was transferred to the London district. He was replaced at Talco by **C. N. Hunt, Jr.,** formerly assistant district superintendent at the Pickton district. **Gayle B. Randolph, Jr.,** district civil engineer, was transferred from Galveston Bay district, Gulf Coast division to Snyder district, West Texas division. **John S. Hacker,** senior civil engineer, Trawick Gas System, transferred to the Pickton district, East Texas division, as district civil engineer. **Wendall S. Westerfield,** civil engineer, Southwest Texas division, was transferred to the West Texas division office as senior civil engineer. **Dandridge W. Marston,** civil engineer, East Texas Division, was transferred to the Goose Creek district, Gulf Coast division, as district civil engineer.

V. L. Garlington was transferred to the new Hamshire construction district as district civil engineer.

A. E. McMillan, district chief clerk, Houston construction district, was transferred to the Hamshire construction district. **Fred L. Rexer** replaced **A. E. McMillan** as district chief clerk at the Houston construction district.

Tom VanNess, tool pusher, Bayou sales district, Louisiana division, was transferred to the Greta district, Southwest Texas division.

▸ **James W. McColl** of Bartlesville, Oklahoma, has been appointed assistant superintendent of Cities Service Oil Company's land department. McColl was first employed by the company in 1939 as landman in the Illinois area, transferring later to the Bartlesville office. He was graduated from the University of Oklahoma Law school in 1938 and was admitted to the Oklahoma Bar the same year.

▸ **Owen "Buzz" Fauntleroy, Jr.,** formerly with the J. M. Huber Corporation at Wichita, Kansas, has joined the firm of William Ross Cabeen and Associates, consulting geologists and engineers. Fauntleroy, a Texas University graduate, will make his headquarters at the firm's home office in North Hollywood, California.

▸ **D. T. Staples** was elected president of oil producers agency of California at the annual meeting of the board of directors in Los Angeles. Staples is executive vice president and a director of Pacific Western Oil Corporation, vice president and director of Mission Corporation and of Mission Development Company, and a director of Getty Realty Corporation. He has been a director of Oil Producers Agency for many years. He succeeds **L. A. Cranson,** executive vice president of Honolulu Oil Corporation, who has served as agency president for the past three years.

R. M. Blodget, who has been executive vice president of the Agency since its founding in 1932, was re-elected. All other officers were re-elected.

▸ **R. W. Gemmer,** chief geophysicist for Carter Oil Company, has been chosen president of the Tulsa section of the Society of Exploration Geophysicists. Other officers are **Craig Ferris,** partner in E. V. McCollum and Company, first vice president; **Dr. J. E. Hawkins,** research director of Seismograph Service Corporation, second vice president; **J. C. Rollins,** interpreter for Frost Geophysical Corporation, secretary; and **Clare N. Hurry,** geophysical operations assistant for Carter Oil Company, treasurer.

▸ **Sam H. Casey,** assistant to the executive vice president, Pan-Am Southern Corporation has been elected as a new member of the board of directors. Casey, who joined Pan-Am in 1948 attended the University of Illinois and Milliken University. He was formerly with Sohio Petroleum Company.

Lawrence H. Norman has been promoted to the assistant to R. L. Aycock, vice president. A former student of Washington and Lee University and the University of Arkansas, Norman was formerly assistant manager of the Crossett Chemical Company.

▸ **Colbert H. Marshall,** Oklahoma City, Oklahoma, has been elected vice president in charge of oil production of Ashland Oil and Refining Company. Marshall formerly was head of the company's oil production in Oklahoma, Texas, and adjoining states. It is a newly created position.

▸ **C. H. Griffin,** Phillips Petroleum Company, Casper, Wyoming, was elected Rocky Mountain district chairman of the American Petroleum Institute division of production at the closing session of the spring meeting in Casper, Wyoming, recently. He succeeded **C. L. Larson, Jr.,** of the Stanolind Oil and Gas Company.

Vice chairmen chosen for the region were: at large—**Paul Kartzke** of Shell Oil Company, Casper; for Colorado—**Fred Clement** of Continental Oil, Denver; for Wyoming—**A. E. Campbell,** Seaboard Oil, Casper; for Montana—**H. F. King** of Continental.

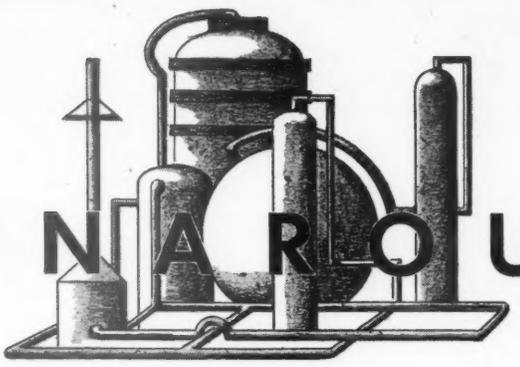
Other newly-elected officers included: **James A. Hill,** Oil Well Supply, Casper secretary-treasurer, and **C. L. Larson, Jr.,** chairman of the advisory committee. New members of the advisory committee are: **R. S. Shannon, Jr.,** Pioneer Oil, Denver; **B. F. Hanly,** Reed Roller Bit, Casper; **Gilbert Mueller,** Argo Oil Corporation, Denver; **Lee Kelton,** Black, Sivalls, Bryson, Casper; **J. L. Dougan,** Equity Oil Corporation, Salt Lake City; **J. G. Dyer,** Dyer Drilling Company, Denver; **W. T. Nightingale,** Mountain Fuel Supply Company, Rock Springs, Wyoming, **T. T. Freeman,** The Texas Company, Denver; **A. P. Lacey,** Continental Supply, Casper, and **R. L. Manning,** Fred M. Manning, Inc., Denver.

Five "Citations for Service" were awarded for outstanding contributions to the district's activities. Recipients of these citations were: **R. B. Curran,** Imperial Oil Company, Ltd., Calgary, Alberta, Canada; **J. D. Anderson,** The Ohio Oil Company, Findlay; **J. C. Johnston,** Continental Oil, Denver; **M. R. McArthur,** Husky Oil, Cody, and **D. T. Hoenshell,** General Petroleum, Casper.

Louis G. Wilke, Phillips Petroleum, Denver, addressed the Friday afternoon session on the public relations problems facing the industry during the present period of military mobilization.

▸ **James W. Adams, Jr.,** geologist, of Shreveport, Louisiana, has joined the production department of Houston Natural Gas Corporation in Corpus Christi. Adams obtained his BS degree from the University of Oklahoma in 1947. He was formerly in the employ of Carter Oil Company, Tulsa, Oklahoma.

▸ **Joseph Neely** was made district geologist for Magnolia Petroleum Company's Shreveport district. He replaces **Everett Eaves,** who has resigned from the company.



THE TURNAROUND

TRAINING

No activity of the oil and gas industries holds so much promise of extraordinary returns on investment as the very rapidly growing program of employee indoctrination and training. Time was when formal education was left to the public schools and the colleges; employers looked for men and women who knew when they came out of school how to do this and that, and any education they might receive came as a matter of course in the carrying out of the job.

Not so, any more, say H. G. Vesper and D. H. Etzler of California Research Corporation, in addressing the recent Mid-Year meet of the American Petroleum Institute's Division of Refining. In a survey covering nearly 100 representative refining companies, carried out by the Industrial Research Institute, it was found that while only 20 per cent of these companies maintain formal, organized systems of employee education, four-fifths of these companies carry on indoctrination methods and on-the-job training programs for their new employees. These various programs range from an occasional lecture by an older employee or company official on some important subject, to the extended program of intensive class-room training headed by a group of the best college professors in the country.

A good example of this intensive training is that given by Humble Oil and Refining Company, to keep its top flight technical men abreast of the latest findings and thinking in these various special fields. This was discussed by Dr. H. D. Wilde, Humble's research director. In the Humble system each professor in his turn comes to the company's headquarters, drops his work completely for the time being and presents his special subject, the field in which he excels and in which he is best informed. A certain restricted number of company employees who have signified their interest in this field are divorced from their regular work and are assigned to these classes. They work at it a full day, each day during the assigned period, a week or more at a time. Each student makes a report on the matters learned; each takes an examination at the end of the course of lectures and the results are presented to the official responsible for the student and for the individual course, to show how much the employees have learned. The sole purpose is to acquaint employees with the latest research data, ideas, methods, and findings, all in the light of the manner by which these newest developments may be applied directly or indirectly to practical technology.

Other companies use different methods, but all pointed to the important job of equipping the company with better technologists, scientists, engineers, to do a better job at refining petroleum, or processing hydrocarbons from whatever source. The avowed purposes in these systems is to:

Give the new grad an idea of the company and its operations.

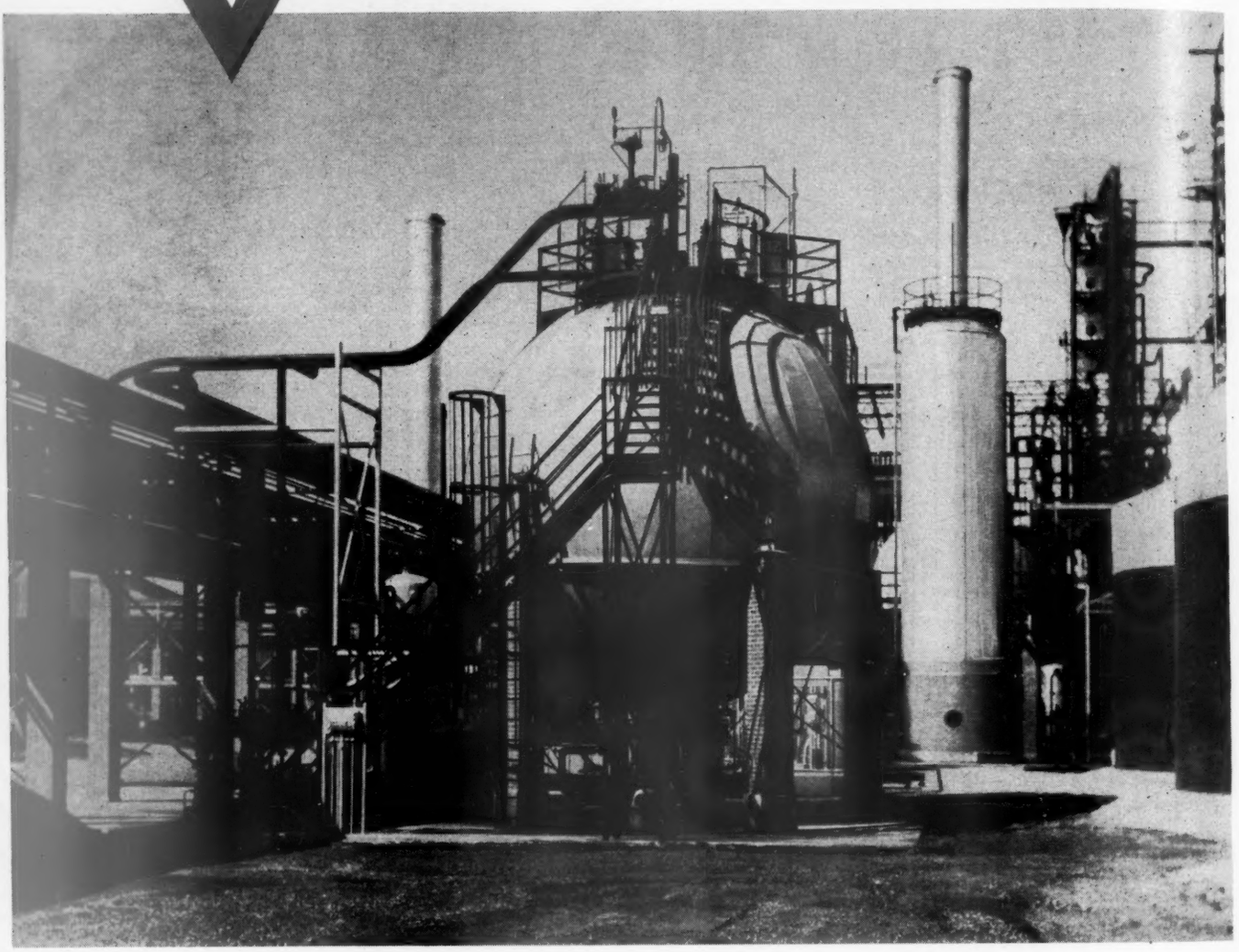
To show the student how his college training may be applied in industry.

To help each man to find the type of work for which he is best fitted.

Those who know most about it say "There is still a large area left to be explored and developed in the training field." So long as men know they have not learned everything yet, just so long the industry will continue to learn, and to progress.—A. L. F.

CONOCO

another leading refiner who desalts with PETRECO



CONTINENTAL OIL COMPANY is now using Petreco Desalting in four different refineries,—New Mexico, Oklahoma, Texas and Louisiana. Four successive installations by a refining organization with Conoco's established reputation is ample evidence that Petreco Desalting proved itself once for Conoco, and has continued to do so with each successive installation. If you want the best in salt removal performance, specify Petreco and be assured of

Minimum Residual Salts and Solids
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PR 51-2

STUDIES IN FLUIDIZATION

Fluid bed technique and factors affecting proper adjustment in its adaptation to petroleum cracking

H. L. OLIN* and J. S. PATTERSON*

GIVEN a vertical cylinder partly filled with a granular solid; at the bottom of the cylinder introduce a uniformly distributed stream of gas and permit it to pass up the column. At any given rate of gas flow the pressure will drop in conformity with Poiseuille's Law relating to flow through capillary channels, in which pressure drop is a direct function of V the linear velocity. So long as the gas velocity is too low to create a force adequate to support any of the solid material no movement of the mass is observed. This is the fixed bed stage illustrated by (a) in Fig. 1. Now let the flow increase until the frictional force or pressure drop exceeds by a differential amount the gravitational force acting on the bed of solids. At this stage each grain is in uniform and maximum contact with the gas. With further flow increase the bed begins to swell and the granules take on a three-dimensional vibratory movement made possible by the increase in void space. This stage known as the fluid state is shown diagrammatically by (b). Finally, further increases in gas velocity set up convection currents in the granular bed with well defined downward flow along the boundary walls and with convergence into an up-flow stream that follows the center line of the container. The system is now in the turbulent fluidized state, (c).

Applications of Fluidization

The phenomenon of fluidization as defined above holds over a wide range of diameter of solid particle. It is subject however, under certain conditions, to abnormalities such as explosive "slugging" and to channeling and in the event of grain adhesion due to the presence of excessive amounts of tars or other fouling agents it may break down completely.

In petroleum cracking practice agitation of the bed particles brought about by the fluidization technique provides uniformity of bed temperature with consequent elimination of the "hot spots" associated with fixed bed practice. The mobility and flow of the catalyst, moveover, permit the setting up of regular periods of reaction and regeneration in the process cycle. Other advantages inherent in the technique include lower mechanical energy requirements, simpler equipment construction and greatly increased rates of heat transfer.

It is evident that a properly adjusted fluidized bed offers almost ideal conditions for contact between gaseous and solid systems. Accordingly, its application to industrial practice which has been rapid in the immediate past is being greatly accelerated. Conspicuous among current and projected applications are catalytic reactions such as the cracking of petroleum and the manufacture of phthalic anhydride by the partial oxidation of naphthalene; the fuel oil synthesis from gases by the Fischer-Tropsch reaction; the gasification of coal or of other solid fuels; the calcination of limestone; the destructive distillation of oil shales; oxidation and reduction reactions of great variety, and in its simplest aspect, the mere transfer of heat between gaseous and solid phases. It is indeed remarkable that the possibilities inherent in so simple and obvious a technique should have been recognized so late by the chemical industries.

Adaptation of fluidization to petroleum cracking is a comparatively recent accomplishment. The revolutionary cracking process put into commercial operation by Houdry in 1936 involves passing hot oil vapors through a battery of fixed bed catalytic reactors or cases, arranged in parallel. As the catalyst in a given case becomes fouled with a deposit of carbon and the reaction activity decreases the flow of vapors is diverted through a suitable by-pass system to another case charged with regenerated material and the fouled bed is burned out in place. In this way the chamber operates alternately as cracker and regenerator.

Operating difficulties are of course obvious. The problem of maintaining catalyst activity in the face of the continuous deposition of carbon on the granular particle can be solved only by a frequent shift from one case to another. Moreover the method of maintaining thermal balance and of removing heat by means of a molten salt stream circulating through a network of pipes within the reactor is in the light of later developments indirect and relatively costly.

A marked advance in catalytic cracking technique was brought about by the adoption of a system with a moving solid phase. Thermofor catalytic cracking developed by Socony-Vacuum was the first process to apply this principle, highly effective in maintaining uniform temperature and in permitting continuous regeneration. It provides for a separation of the reaction and regeneration zones and for continuous movement of catalyst through each. The fouled granules falling from the bottom of the reactor are lifted by means of a bucket elevator to a separate furnace where the carbon is burned off. The reactivated material dropping from the base of this furnace is reelevated to the top of the reactor to complete the cycle. Although the process is highly successful in general, an elevator system with a capacity adequate for circulating the catalyst is a critical element of the design.

Still another successful method is the "fluid" cracking process devised by Standard Oil Development. Their original scheme embodied the "up flow" design wherein the total stream of catalyst and vapors is taken overhead from the reactor to a dust recovery system. Later development work has resulted in the modified "down flow" process in which the stream velocity is decreased to such an extent that the solids tend to concentrate in the gas stream to form a dense, turbulent bed with clearly defined boundaries. A distinct pseudo-liquid phase or dense bed exists above the bed support and above this in turn is a separate pseudo-gas phase. From this stage to the adoption of true fluidization was an obvious if not a simple step.

*Division of Chemical Engineering, State University of Iowa, Iowa City, Iowa.

EXCLUSIVE

The Literature on Fluidization

With the rapid increase in interest in fluidization has come a flow of technical papers bearing on the subject. Fortunately the reader interested in following its development has two readily accessible bibliographies at his disposal, which *with their citations to the earlier literature,* cover the important contributions that have appeared. The first (1) consists of a symposium of 15 papers of a general nature embracing all phases of fluid flow; the second (2), of 21 papers bearing more directly, as the group title indicates, on fluid-solid systems. Conspicuous for their pioneering work in the special subject of fluidization are Leva of the U. S. Bureau of Mines, Lewis of Massachusetts Institute, Murphree of Standard Oil Development, Parent of the Illinois Gas Institute, Wilhelm of Princeton, and many others but due credit must be given to the host of earlier workers who laid the foundations on which fluid mechanics is built.

Purpose and Scope of Study

Many of the applications of fluidization to technology involve chemical or thermal reactions in which neither free carbon nor tarry or waxy substances are formed to foul the granular bed. Oxidation reactions in general belong to this class throughout their entire temperature ranges. Certain organic syntheses may be relatively clean if carried out below a critical temperature but may yield tars in the higher ranges required for effective catalyst activity. The cases in which foreign substances formed either by thermal cracking or by synthesis cause serious trouble are so frequent however as to warrant a special study of *fouled* beds as distinguished from those that remain clean throughout the course of the reaction. It is with that phase of the subject that this paper is chiefly concerned, but results of certain general studies confirming findings of earlier investigators are included.

The fouled systems studied, designed to simulate conditions that might be encountered in practice, were set up by decanting tars and waxes carried in suitable solvents through the sands to be used. Drainage of excess solution and evaporation of solvent left on each sand grain a film of additive foreign material, whose effect on fluidized flow was then studied and observed.

Apparatus Design. The fluidization apparatus used in these studies, fairly conventional in design, is shown in Fig. 2. It includes a 28 in. flanged glass fluidizing column 4⅜ in. i.d., a cyclone dust separator, a silica gel air drying tower, a calibrated orifice ⅛ in. i.d., an air moisture indicator, an air flow solenoid valve regulator, a back pressure reducing diaphragm valve and instrument boards on which the measuring equipment was mounted. Sensitivity in low pressure drop measurements was obtained by use of an inclined-type draft gage equipped with a micrometer screw adjustment. Carbitol, sp. gr. 0.990 at 20 C was used as manometer fluid to provide greater sensitivity of measurement.

The apparatus was designed to duplicate as nearly as possible a typical dense bed fluidization unit. Linear velocities of air used duplicated those of the typical fluidizers employed in petroleum practice and in current Fischer-Tropsch reactor design but did not cover the velocity ranges to which the latter will probably be raised. Filtros plates sealed in ½ in. lengths of standard 4½ in. iron pipe were used as diffusers for the entering air and as supports for the catalyst beds. They seem ideally suited for this use because of their uniform permeability and their high structural strength.

Materials Used in the Study

Clean Sand. A white Ottawa sand of 99.8 per cent silica content and with a true specific gravity of 2.65 was chosen as the solid medium to serve in most of these studies. Ottawa sand (St. Peter's sandstone) is peculiarly fitted for fluidization studies of this kind because of the well rounded edges it acquired in the long ages of wind and wave action it underwent before finally coming to rest in the Early Paleozoic (Ordovician). As a result of this wear its grains are roughly spherical in shape (if some tolerance may be permitted in the qualifying term, *roughly*) at least in comparison with the sharply angular sands deposited in the Late Pleistocene from glacial drifts. These sands were screened and classified with meticulous care with the aid of a Ro-Tap to obtain a series of fractions ranging in size from plus 36 to minus 200 mesh. The resultant particle diameter was computed as the geometric mean between consecutive screen size. For mixed sizes the average particle diameter was calculated from equation (3)

$$(1)\quad D_p = \sum_{z=1}^{z=z} (X\, d_p)\, z$$

where X is the weight fraction of a component of the mixture, d_p the effective diameter of a component particle and z number of components present.

Fouled Sands. For the runs made with fouled sands the following agents were used: (a) petroleum jelly, sp. gr. 0.84 at 25 C; (b) paraffin wax, S. O. "Parowax," sp. gr. 0.89 at 25 C; (c) (pine tar and pine rosin with sp. grs. of 1.067 and 1.070 respectively; (d) asphalt tar, sp. gr. 0.993 at 25 C. Each of these materials was applied to clean sands of equivalent weight and grain size by dissolving them in petroleum ether and covering the sand with the solution for a time sufficient to wet it completely. Excess solution was decanted and the sand dried by evaporation. The amount adhering to the solid was then computed as the difference between weight applied and the amount recovered from the decanted fraction. Knowing the average grain diameter it was then a simple matter to compute the average thickness of the adherent film.

Cracking Catalysts. Runs were also made in which a silica-alumina petroleum cracking catalyst made by the Davison Chemical Corporation was used in the fresh, the spent and the regenerated conditions. This material had a true density as determined by the pyknometer of 2.40 gms/cc. and an average particle diameter of 0.0017 in. or 43 microns.

Relation Between Pressure Drop and Modified Reynold's Number

The relations observed between pressure drop through the column and the modified Reynold's number (D_p the particle diameter is substituted for D the diameter of the capillary channel) for clean sands as plotted in Figs. 3 and 4 are in agreement with the earlier observations of Wilhelm (4), i.e., a 45 degree curve through the static zone, discontinuity with pressure drop through the critical transition gap and final constancy of pressure drop over the fluidization range. The beginning of turbulent fluidization is identified in each graph by the point at which no further increase in pressure drop is observed with increase of air flow. Fig. 5 shows graphically the effect of particle diameter on the rate of flow necessary to initiate fluidization.

Channeling of gases through beds of extremely fine particles such as the cracking catalysts used in this study is more prevalent than in beds of larger granules. This observation, reported earlier by Parent (5) is definitely confirmed by our own results. Masses of fine material without an adequate proportion of coarser aggregate tend to cohere strongly by reason of electrostatic effects, and channels are quickly formed when fluidization is attempted; loss in pressure head is then due to flow through the channels produced. Initial tests on our catalyst material gave erratic results because of such channel formation when the air stream was introduced at progressively higher rates of flow. A common phenomenon observed was a kind of

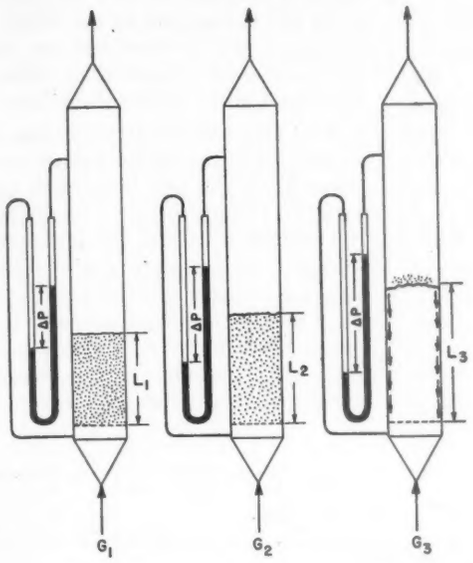
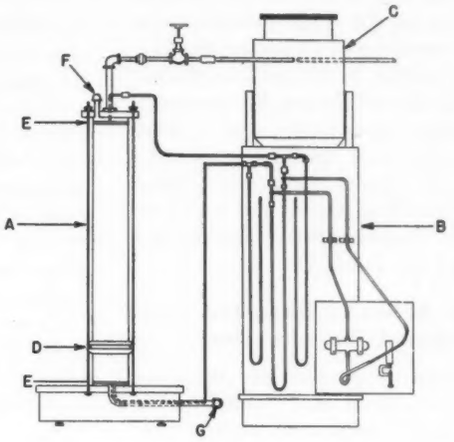


FIG. 1. The three stages of fluidization.



LEGEND

A–FLUIDIZATION COLUMN (4-3/8", I.D.)
B–MANOMETER PANEL
C–CYCLONE DUST SEPARATOR
D–FILTROS POROUS PLATE
E–PIEZOMETER RINGS
F–CHARGING NIPPLE
G–AIR INLET LINE

FIG. 2. The fluidization apparatus.

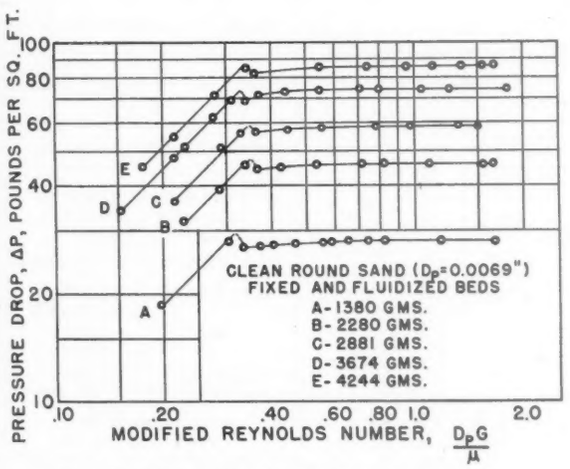


FIG. 3. Effect of bed weight on fluidization pressure drop.

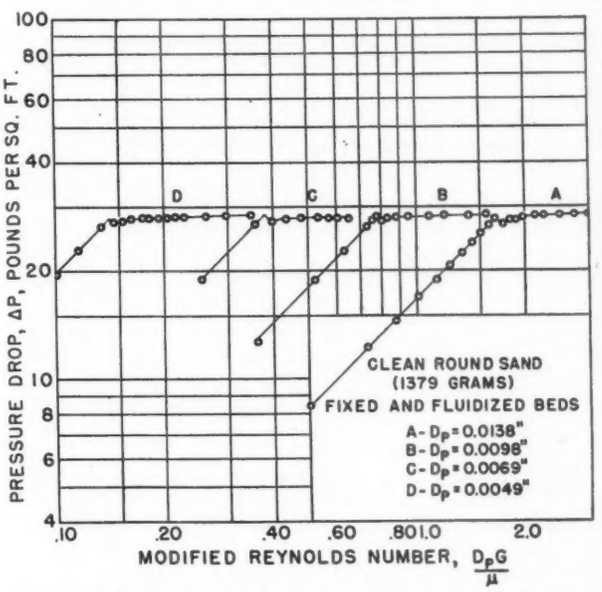


FIG. 4. Effect of grain size on fluidization conditions.

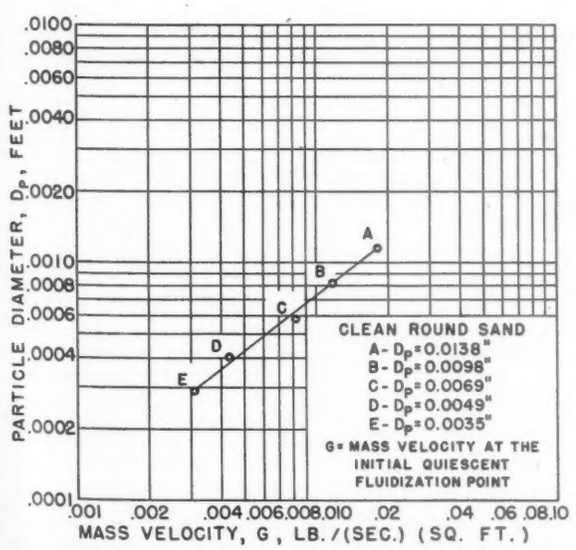


FIG. 5. Mass rate of flow at initial fluidization vs. D_p.

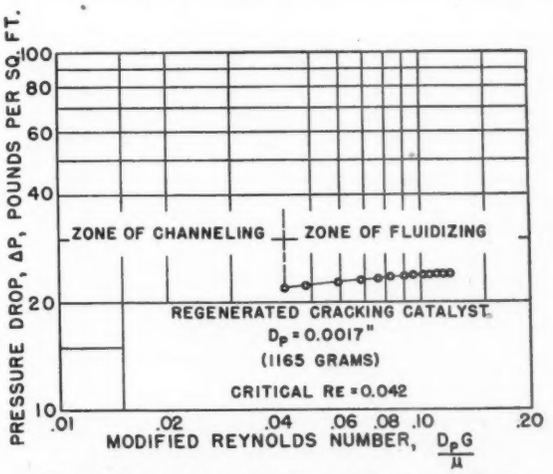


FIG. 6. Flow characterstics of fresh catalyst.

"spouting" that carried granular material to the top of the column even at low values of *Re*. This difficulty was largely overcome by *reducing* the flow from an initial turbulent condition; as a result the minimum *Re* necessary to maintain fluidization was exactly reproducible. For fresh, regenerated and spent catalyst materials these values were 0.045, 0.042 and 0.037 respectively. Representative curves are shown in Figs. 6 and 7.

Relation Between Observed and Computed Pressure Drops

Fig. 8 shows graphically the data obtained on clean and fouled sands and on fresh, spent and regenerated catalyst materials in the fluidized regions when the ratios of observed to calculated pressure drops (the latter being equivalent to the bed weight) were plotted against the modified *Re*. Values of $\frac{\Delta P_o}{\Delta P_c}$ to the left of the vertical at abscissa 1 show negative deviations due presumably, to the presence of unfluidized solid material in the column. The data on clean sands, curves A, B, C and D, indicate that once turbulence has been attained the ratio becomes constant at 0.98. In the case of the catalysts at low values of *Re* the ratio is greater for the fresh than for the regenerated, but at the higher rates the reverse relation holds. This may be explained by the fact that at the higher values of *Re* electrostatic effects were prominent in the fresh material and that considerable quantities of dust were immobilized on the walls of the tube whereas the phenomenon did not appear in the other case. It seems evident that loss in weight of floating bed more than offset the frictional effect of the static layer.

The effect of fouling on this ratio is strikingly shown by comparison of curve B on the one hand with curves E, F, G, H and I on the other. Clearly, the influence of the foreign material added is to promote the agglomeration into "balls" that did not form a part of the fluidized system. In the case of less tacky substances such as pine rosin the effect is somewhat less evident than with sticky tars.

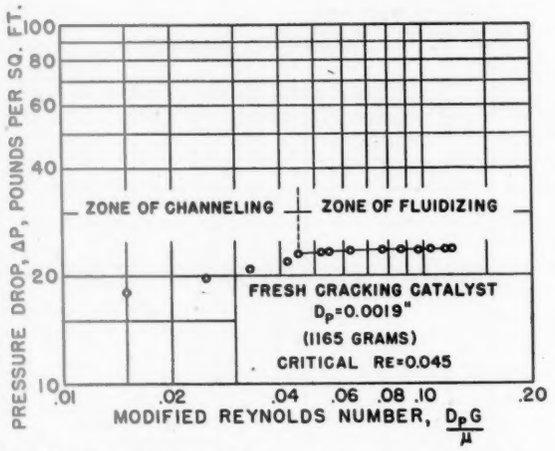


FIG. 7. Flow characteristics of regenerated catalyst.

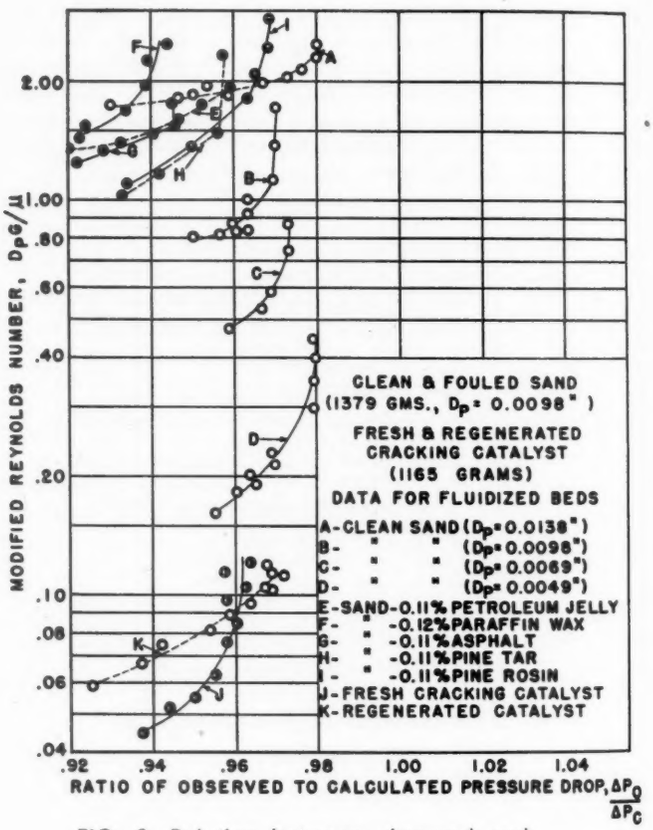


FIG. 8. Relation between observed and computed pressure drops.

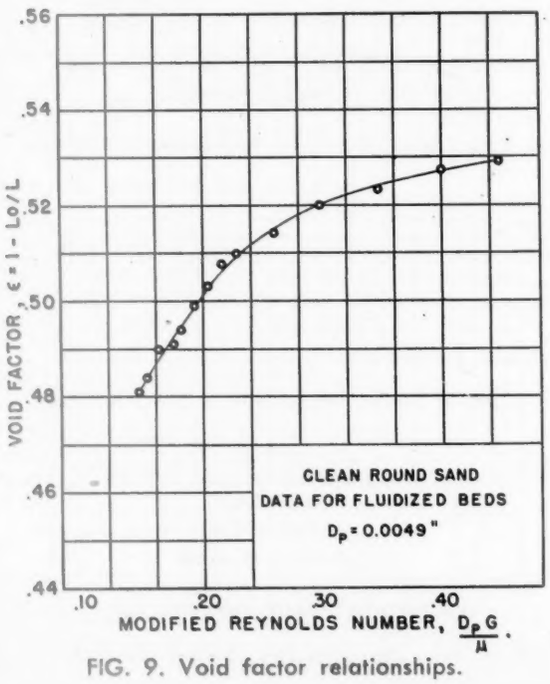


FIG. 9. Void factor relationships.

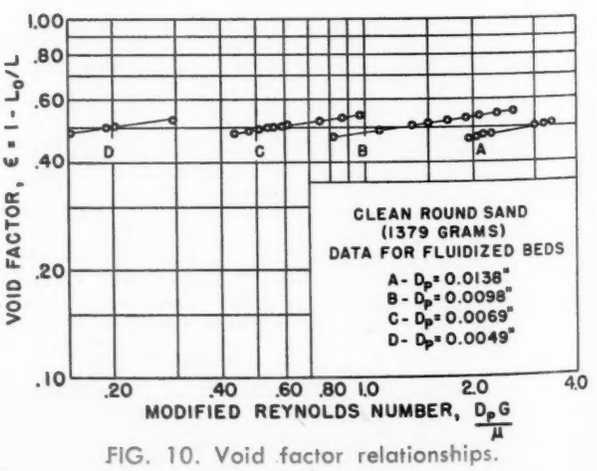


FIG. 10. Void factor relationships.

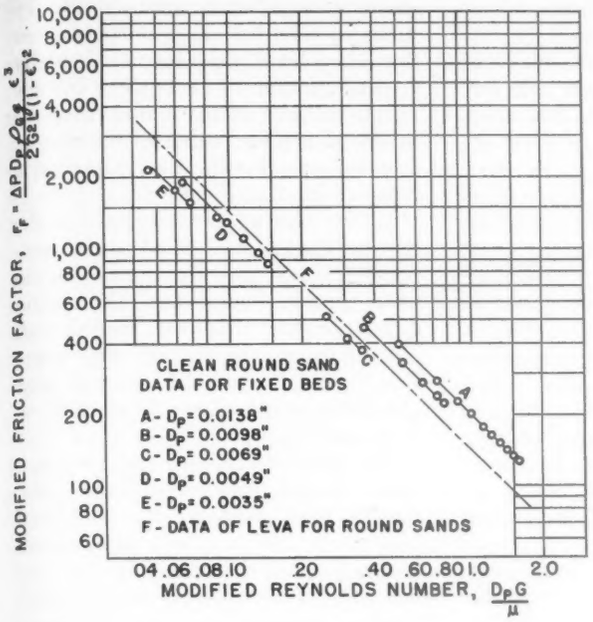


FIG. 11. Friction factor—Corrected for voids.

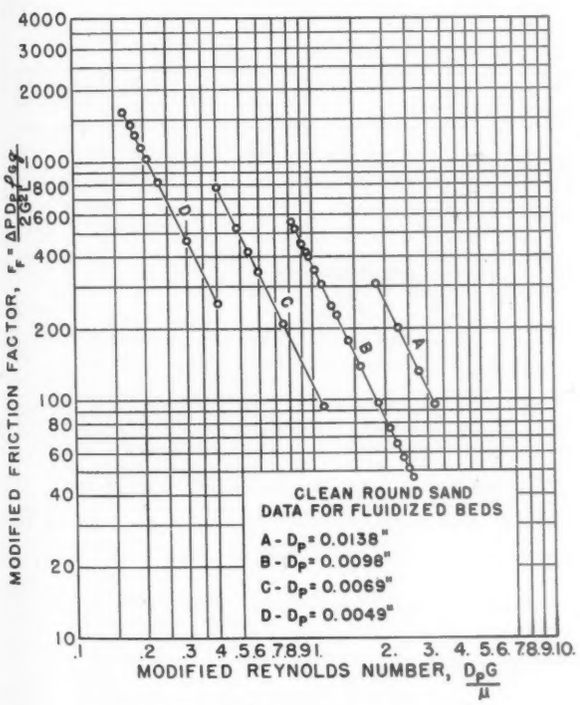


FIG. 12. Friction factor—Fluidized beds.

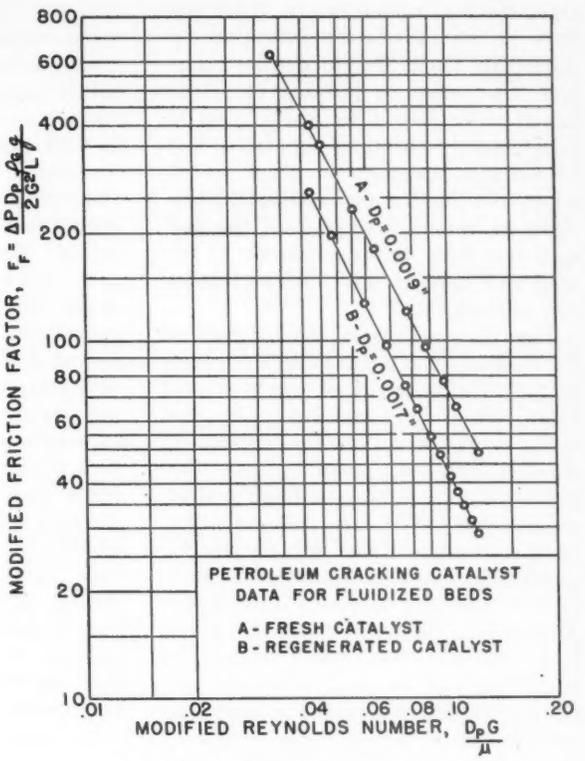


FIG. 13. Friction factor—Fresh and regenerated catalyst.

Void Factor Relationships

The void factor is defined as $\frac{L - L_o}{L}$ in which L is the height of the sand column under any given condition and L_o is the height of an equivalent bed without voids, computed from true particle density, the weight of the bed and the cross section area of the column. In the fixed bed zone of particles of ideal spherical shape the void factor is a constant, a unique function of grain diameter except so far as the intensity of the initial crowding or packing force exerted on the material in the column may have varied. In this stage with increasing gas flow the pressure drop induced by friction mounts, but no perceptible change in the density of the bed takes place. At the borderline of fluidization, however, as the gravitational force acting on the sand is equalled and exceeded and through a fairly narrow range of *Re* the bed swells and expands up the column. This phase is followed by bubbling and other convectional phenomena involving work, on which any additional gas pressure forces are expended. From this time on the change in bed height to force applied, dh/df, diminishes although it does not necessarily become constant.

A typical plot of such values against *Re* for a clean sand of diameter 0.0049 in. is shown is Fig. 9. Data plotted on the log-log scale for a range of sand diameters from 0.0049 to 0.0138 in. are presented in Fig. 10. Over the range of size diameters studied the following empirical equation holds:

$$(2) \quad \frac{L - L_o}{L} = \varepsilon = (0.033)/D_p^{0.86}\,Re^{0.14}$$

Friction Factor Studies

Fig. 11, which represents data on the flow of air through clean sands in the quiescent or fixed bed state, shows a correlation of the modified Fanning friction factor f, defined by the equation

$$(3) \quad f_f = \frac{\Delta P D \rho_f g}{2 L G^2}$$

corrected for voids by use of the Kozeny function, $\frac{\varepsilon^3}{(1-\varepsilon)^2}$, plotted against *Re*. The latter expression adapted by Carman (6) from earlier work of Kozeny (7) on capillary flow of water in soils was highly effective in accounting for differences in P/L with grain size and when so employed the curves for different particle diameters group closely together although they do not fall on a common line. It seems probable, however, that the mean of a family of curves drawn for individual grain size may be sufficiently accurate for engineering de-

sign. Such a mean drawn from our data coincides exactly with that reported by Leva (8) for similar material. The relations holding for clean sands were found to apply also to fouled sands with 0.12 per cent or less of foreign material. In other words where the amount deposited is insufficient to immobilize parts of the bed or where little or none adheres to the wall the normal flow characteristics are unchanged.

Fig. 12 gives the results of plots of the Fanning f against *Re* in the range of fluidization in which grain size is highly significant as shown by the wide separation of the curves. A marked difference also appears between friction factors of fresh and of regenerated catalyst as shown in Fig. 13. Factors calculated for the regenerated material were found to be only 58 to 65 per cent of those for the fresh. Apparently, the higher superficial velocity through the former is due in part to greater volume. Moreover, the regenerated catalyst probably approached more closely the microspheroidal shape through wear of edges after a period of service. Finally, residual carbon may have exerted a lubricative effect between individual particles as well as at the container walls. Friction factor f relationships for the two conditions may be expressed by the following equations:

$$(4)\quad \text{fresh } f_f = \frac{\Delta P\, D\, \rho_f\, g}{2\, G^2 - L} = 0.80\ (\mathrm{Re})^{-1.98}$$

$$(5)\quad \text{regenerated } f = \frac{\Delta P\, D\, \rho_f\, g}{2\, G^2 - L} = \frac{0.38}{(\mathrm{Re})^{-2.06}}$$

Pressure Drop Studies

A striking demonstration of the effects of fouling on the flow characteristics of granular solids is provided by plots of pressure drop versus the modified *Re*. It is evident from the well-known physical properties of the fouling agents listed that they differ greatly. In the form of films applied to a grain surface rosin and petroleum jelly for example, might be expected to act as lubricants while pine tar and soft asphalt on the other hand, which are notoriously sticky should to some degree set up resistance to flow shear, a conclusion supported in part by the evidence provided by the results plotted in Figs. 14 to 18.

A striking and doubtless, significant fact regarding a film of this kind is that it is extremely thin. For example, a 3 mm. catalyst bead developed for the Thermofor process and used to some extent in Houdry practice (9) has a pore surface area of 420 square meters per gram or more than 2,000,000 sq ft per pound. Since the maximum carbon fouling that may be tolerated with respect to satisfactory catalytic activity is about 1 per cent the weight of carbon normally deposited is 0.01 pound per pound of catalyst. Assuming uniform distribution over the entire pore area the carbon film then has a thickness of approximately 3.6×10^{-12} in., equivalent to 9×10^{-8} microns or 9×10^{-4} angstrom units. The catalyst bead in question moreover, has a pore channel diameter of 270 billionths of a centimeter or 27 angstroms, so that conceivably, the space available is amply sufficient to accommodate a film lining of that dimension. But our assumption of uniform film coverage breaks down in the face of the film thickness computed above, since the diameter of the carbon atom is of the order of 2 angstroms. It follows, therefore, that the carbon adsorption must be highly irregular or spotty. Indeed this conclusion agrees with modern theories of adsorption (10) that postulate activated insular areas surrounded by fields of relatively inert surface. If on the other hand we adopt the equally faulty idea that the carbon lies entirely on the surface of the 3 mm. bead we arrive at a mean value of 0.006 mm. or 6 microns for the film thickness, a value much too great.

In the case of the sand used in the present work, which is of course nonporous silica, the films must lie entirely on the outer surface. On a grain 0.0098 in. in diameter fouled with percentages of petroleum jelly varying from 0.06 to 0.45, simple computations give values from 0.08 to 0.50 microns.

The plots of pressure drops through sands fouled with petroleum jelly, paraffin wax, asphalt, pine tar, and pine rosin are basically similar but the spacing of the curves in the fixed bed zone varies with the nature of the fouling material and the degree of fouling. A shift in the initial point of fluidization from that obtained with comparable clean sand was observed

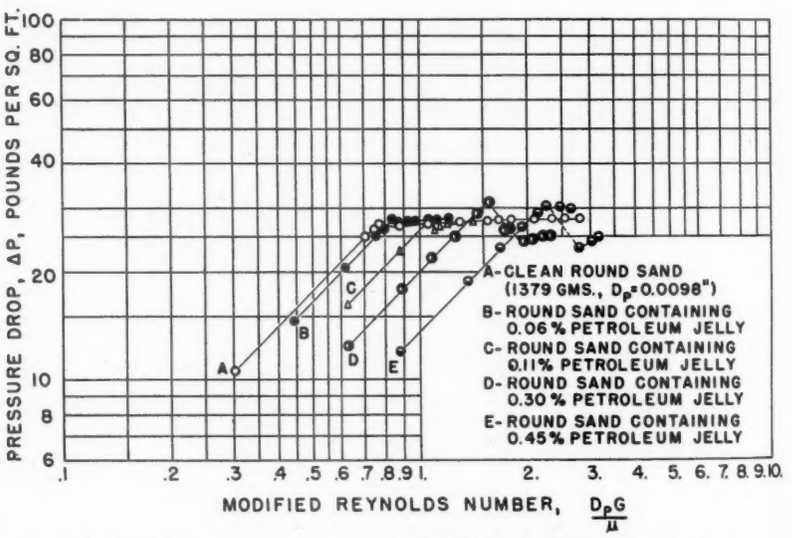


FIG. 14. Pressure drops through fouled beds—Petroleum jelly.

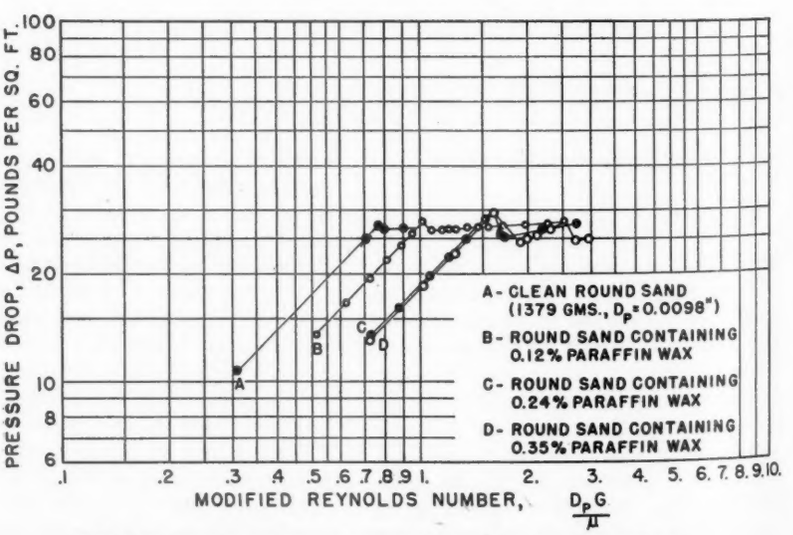


FIG. 15. Pressure drops through fouled beds—Paraffin wax.

in each case but once this stage was reached pressure drops remained constant with increasing *Re* at values identical with those for the clean material. This observation was true however, only if the amount of fouling material was insufficient to *immobilize any part of the bed*. With intermediate and heavy applications pressure drops went down because of the setting up of zones of immobility of greater or less thickness which extended out from the walls of the tube toward the center. When fluidization occurred in highly fouled beds the cylindrical center section "boiled" although relatively little convection took place. At progressively higher air velocities sand was transferred from the bed center to build up these outer shells. At the same time the height of the center mobile section diminished except when cavitation in the outer layer occurred.

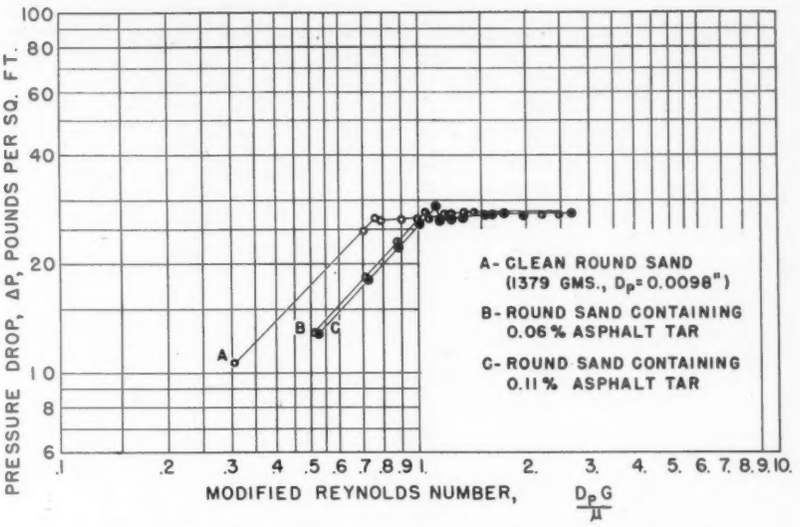

PRESSURE DROP, ΔP, POUNDS PER SQ. FT.
MODIFIED REYNOLDS NUMBER, $\frac{D_p G}{\mu}$
A- CLEAN ROUND SAND (1379 GMS., D_p= 0.0098")
B- ROUND SAND CONTAINING 0.06% ASPHALT TAR
C- ROUND SAND CONTAINING 0.11% ASPHALT TAR

FIG. 16. Pressure drops through fouled beds—Asphalt tar.

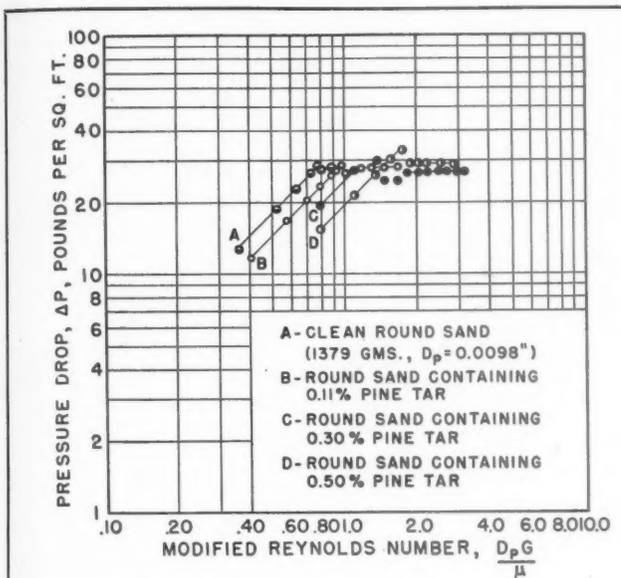

PRESSURE DROP, ΔP, POUNDS PER SQ. FT.
MODIFIED REYNOLDS NUMBER, $\frac{D_p G}{\mu}$
A- CLEAN ROUND SAND (1379 GMS., D_p= 0.0098")
B- ROUND SAND CONTAINING 0.11% PINE TAR
C- ROUND SAND CONTAINING 0.30% PINE TAR
D- ROUND SAND CONTAINING 0.50% PINE TAR

FIG. 17. Pressure drops through fouled beds—Pine tar.

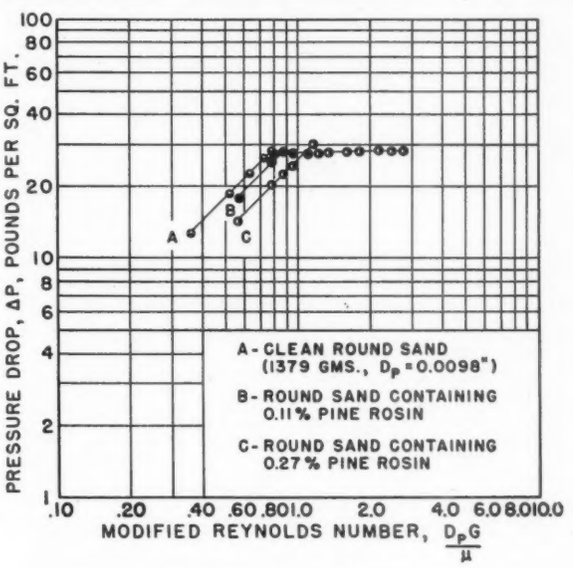

PRESSURE DROP, ΔP, POUNDS PER SQ. FT.
MODIFIED REYNOLDS NUMBER, $\frac{D_p G}{\mu}$
A- CLEAN ROUND SAND (1379 GMS., D_p= 0.0098")
B- ROUND SAND CONTAINING 0.11% PINE ROSIN
C- ROUND SAND CONTAINING 0.27% PINE ROSIN

FIG. 18. Pressure drops through fouled beds—Pine Rosin.

"Slugging" or explosive convection is a phenomenon observed under certain conditions of gas flow through solids. With extremely fine dusts it is especially troublesome, often due to the accumulation of electrostatic charges that freeze parts of the bed to the container wall or that form local agglomerations elsewhere. In the case of fouled granules adhesive and other forces may join to aggravate the situation. The concept of ideal fluidization rules out obstructive forces that prevent contact of the gas with each individual granule.

Pressure drop phenomena shown by the plots in question may be explained by reference to Leva equation (8) (based on Kozeny function) for flow of gases through fixed beds:

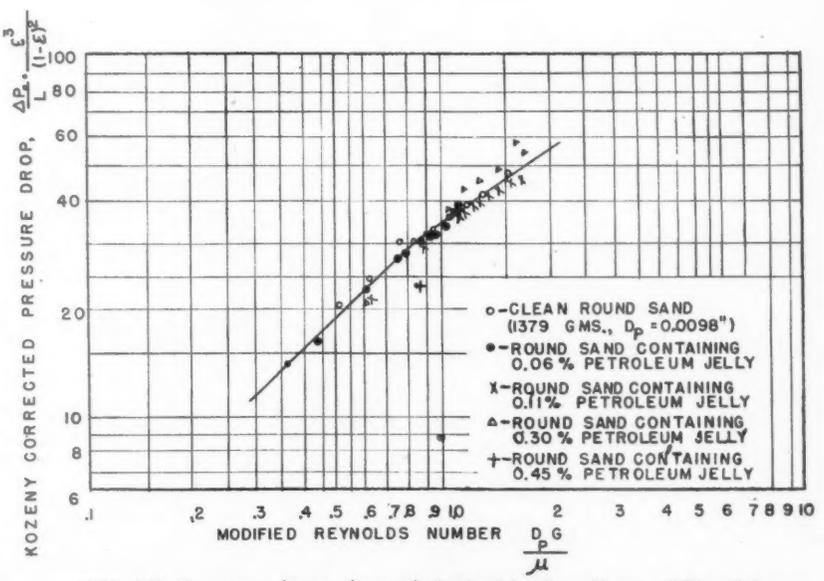

KOZENY CORRECTED PRESSURE DROP, $\frac{\Delta P}{L}\cdot\frac{\varepsilon^3}{(1-\varepsilon)^2}$
MODIFIED REYNOLDS NUMBER $\frac{D_p G}{\mu}$
o-CLEAN ROUND SAND (1379 GMS., D_p =0.0098")
•-ROUND SAND CONTAINING 0.06% PETROLEUM JELLY
X-ROUND SAND CONTAINING 0.11% PETROLEUM JELLY
Δ-ROUND SAND CONTAINING 0.30% PETROLEUM JELLY
+-ROUND SAND CONTAINING 0.45% PETROLEUM JELLY

FIG. 19. Pressure drops through fouled beds—Data of Fig. 14 replotted with Kozeny Correction Factor.

TABLE 1. Pressure drop through fouled beds. Fouling agent, petroleum jelly $D_p = 0.098$ in.

Run No.	Re	$\frac{\Delta Po}{L}$	ΔPo	ε	$\frac{\varepsilon^3}{(1-\varepsilon)^2}$	$\frac{Po}{L} \times \frac{\varepsilon^3}{(1-\varepsilon)^2}$	L
Series 48, clean sand							
1	.360	38.5	10.71	.467	.360	13.9	.330
2	.521	57.0	18.78	.467	.360	20.5	.330
3	.630	68.8	22.69	.467	.360	24.8	.330
4	.755	83.5	27.58	.467	.360	30.1	.330
5	.795	83.3	27.50	.468	.360	30.0	.330
6	.827	84.2	27.84	.468	.364	30.7	.331
7	.883	83.3	27.93	.475	.389	32.4	.335
8	.929	83.4	28.04	.476	.394	32.9	.336
9	1.08	81.8	28.11	.487	.442	36.2	.343
10	1.25	80.5	28.10	.496	.482	38.8	.349
11	1.72	76.6	28.24	.523	.632	48.5	.369
Series 31, fouling, 0.06 per cent							
1	.445	44.1	14.59	.468	.364	16.10	.335
2	.623	62.3	20.65	.468	.361	22.70	.331
3	.756	76.4	25.30	.468	.361	27.55	.331
4	.874	83.1	27.54	.468	.361	30.00	.331
5	.923	82.8	27.65	.472	.380	31.50	.334
6	.972	83.0	27.70	.472	.380	31.50	.334
7	1.06	82.5	27.95	.480	.410	33.80	.339
8	1.12	80.8	27.80	.488	.441	37.30	.344
9	1.20	80.2	27.81	.492	.462	39.40	.347
10	.795	78.8	26.08	.468	.361	28.40	.331
11	.841	83.4	27.60	.468	.361	30.20	.331
Series 32, fouling, 0.11 per cent							
1	.627	45.3	15.87	.497	.484	21.90	.351
2	.878	63.7	22.35	.497	.484	30.80	.351
3	1.08	77.7	27.25	.497	.484	38.60	.351
4	1.10	72.6	25.60	.500	.500	36.30	.353
5	1.13	75.2	26.53	.500	.500	37.60	.353
6	1.19	76.3	27.00	.501	.506	38.60	.354
7	1.24	76.0	26.88	.501	.506	38.50	.354
8	1.30	75.4	26.83	.504	.520	39.20	.356
9	1.35	75.3	26.85	.505	.527	39.60	.357
10	1.40	75.8	27.80	.508	.543	41.10	.359
11	1.48	—	27.45	.512	.563	42.70	.362
12	1.60	75.8	27.60	.515	.581	44.10	.364
13	1.76	75.8	27.75	.519	.606	45.90	.367
Series 33, fouling, 0.30 per cent							
1	.627	32.8	12.37	.528	.657	21.6	.377
2	.879	47.3	17.84	.528	.657	31.0	.377
3	1.08	56.7	21.70	.528	.657	37.2	.377
4	1.25	65.7	24.79	.528	.657	43.2	.377
5	1.35	71.1	26.85	.528	.657	46.7	.377
6	1.45	75.5	28.50	.528	.657	49.6	.377
7	1.57	80.0	31.00	.541	.754	60.3	.387
8	1.65	71.6	27.92	.543	.766	54.8	.387
Series 34, fouling, 0.30 per cent							
15	2.29	62.2	25.22	.561	.923	57.3	.405
16	2.74	61.7	25.30	.567	.973	60.1	.410
17	2.60	63.3	25.60	.561	.923	58.4	.405
18	2.47	61.3	23.85	.543	.766	47.0	.389
19	2.30	54.4	20.70	.533	.698	38.0	.381
Series 45, fouling, 0.45 per cent							
1	.884	30.5	11.86	.541	.754	23.0	.387

Table 2. Pressure drops in mixed runs $D_p = 0.0098$ in.

Fouling agent	Re	Per cent fouling	Kozeny function $\frac{3}{(1-\varepsilon)^2}$	Po	$\frac{Po}{L} \times \frac{3}{(1-\varepsilon)^2}$
Wax	0.623	0.06	.361	20.65	22.50
jelly	0.622	0.12	.431	16.72	21.00
Wax	1.245	0.30	.659	24.79	43.35
jelly	1.237	0.24	.623	22.72	38.15
Wax	1.245	0.30	.659	24.75	43.33
jelly	1.245	0.35	.697	22.73	41.55

$$(6)\quad \Delta P = \frac{k}{g} \cdot \frac{(D_p G)}{\mu} \cdot \frac{(\mu)^2}{\rho_f} \cdot \frac{\lambda^2}{D^3_p} \cdot \left(\frac{(1-\varepsilon)^2}{\varepsilon^3}\right),^*$$

or by holding all factors constant except $\frac{(1-\varepsilon)^2}{\varepsilon^3}$

$$(7)\quad \Delta P = C \frac{(1-\varepsilon)^2}{\varepsilon^3}$$

and, with introduction of the dependent variable L, the height of the bed,

$$(8)\quad \frac{\Delta P}{L} \cdot \frac{G^3}{(1-\varepsilon)^2} = k$$

By correcting pressure drop values of fouled beds observed with varying *Re*, by use of the Kozeny function as shown in Equation (8) the effects of voids and vagrant channels are nullified and the relationship of $\frac{\Delta P}{L} \cdot \frac{\varepsilon^3}{(1-\varepsilon)^2}$ vs. *Re* may be represented by a fairly smooth curve. Data recorded for runs with petroleum jelly for example, originally plotted in Figure 14 are corrected in Table 1 and replotted in Figure 19. Similar relationships hold for runs with the other agents used and for pressure drops in mixed runs, as shown in Table 2. It was observed however, with fouling percentages of 0.45 and higher that flow characteristics became so erratic as to make accurate measurements of the height of the bed extremely difficult or impossible. The Kozeny correction consequently could not be applied to the data in this series.

It seems plausible that decreased catalytic activity universally observed in industrial practice with progressively increased fouling of the particle may be due to at least two causes: the reduction of surface activity through the deposition of an insulating or neutralizing coat, *and* the isolation of the particle through diversion of the circulating gas through large channels.

Work in progress in our laboratory at the present time is directed toward measuring the effects of fouling on heat transfer phenomena.

*Symbols: μ and ρ are fluid viscosity and density resp., λ is a shape factor (dimensionless), ε is percentage of voids and g is the acceleration of gravity.

Nomenclature Symbols

D_p = particle diameter, equivalent to diameter of sphere of equal volume, ft.

ε = void factor, dimensionless, equal to $\frac{L - L_o}{L}$

f_f = modified Fanning friction factor, dimensionless.

g = acceleration of gravity, ft/sec^2.

G = mass velocity of fluid, based on empty vessel, lb/(sq ft)(sec.).

L = height of bed at any instant, ft

L_o = height of bed free of voids, ft

ΔP = pressure drop, lb/sq ft

R_e = modified Reynolds number, $\frac{D_p G}{\mu}$

Z = number of components in a mixture, dimensionless.

μ = fluid viscosity, lb/(sec)(ft)

ρ_f = fluid density lb/cu ft.

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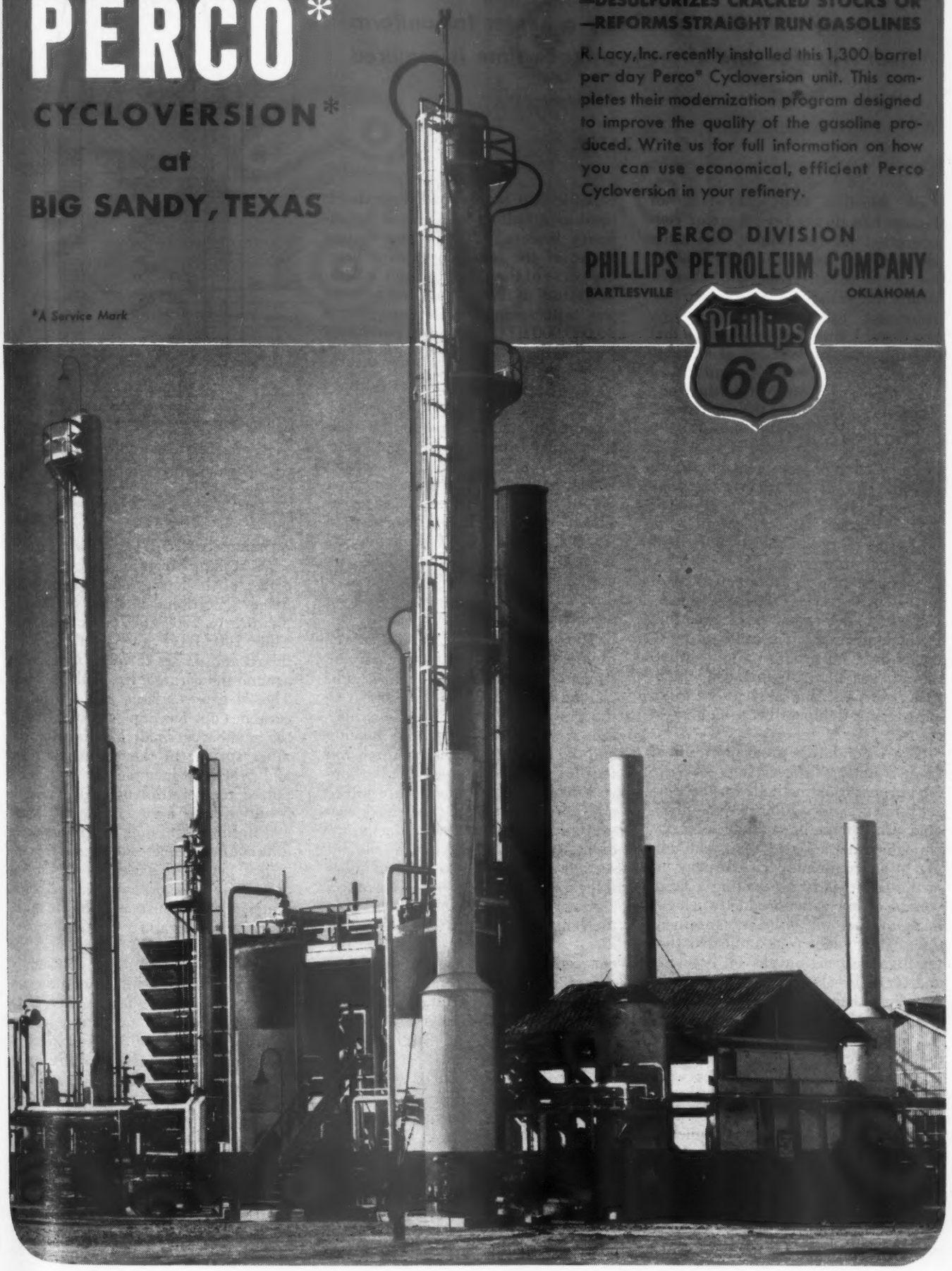


New Development in Radiant Heating†

For many purposes in refinery a heater for uniform heat transfer and short residence time is required

C. C. TATE*

THE selection and operation of heaters has always been a major consideration for the refiner. The refining industry is continually looking for a more effective and cheaper means of satisfying the heater requirement for both old and new processes. I am sure we all agree that through the development of refining methods more time, effort, and money have been spent on heaters than any other one part of the integrated equipment that goes to make up a refinery.

As a part of our continuing research, two separate investigations developed information that resulted in the commercial application of a new type of radiant heat source for petroleum processing.

The first investigation consisted of an extensive series of semi-commercial tests to determine the best thermal method of cracking a catalytic cycle oil, in order to produce a low aniline number gas oil. Tests included single-pass, two-pass, and recycle cracking, at varying temperatures and pressures.

The second test program resulted from a study of the various catalytic feed preparation methods for the Borger refinery, which indicated the probable production of a high viscosity paraffinic vacuum residuum, amounting to approximately 12 LV per cent of the crude and representing a large volume of low value product when cut back to fuel oil viscosity specifications. Pilot plant tests indicated that for high destruction gas oil cracking and for visbreaking vacuum residuum a radiant heater designed for short residence time, uniform heat transfer, and some control of the shape of the heating curve was required.

About this time two articles were published—one by J. H. Rickerman[1] and another by L. A. Mekler[2]—both of which mentioned that a flameless ceramic cup burner had been developed as a radiant heat source for refinery heaters, allowing any desired shape of the time-temperature heating curve of the oil. As a result, a demonstration of the ceramic cup burners was witnessed and, subsequently, a 30,000,000 BTU heater was purchased for the Borger refinery.

Description of Furnace and Burners

The new heater was shipped in two sections, namely radiant and convection, and was installed in a very short time at minimum cost. The heater is constructed with the radiant coil placed midway between the sides as shown in Fig. 1. The radiant section is 38 ft 6 in. long, 5 ft wide, and 12 ft high (inside dimensions). The convection section is 38 ft 6 in. long, 2 ft 3 in. wide, and 6 ft 7½ in. high. Total ground area covered is 860 sq ft.

The oil enters the furnace at the top and splits into two parallel streams that pass through a 42-tube convection section counter-current to the flue gases. The convection tubes are on equilateral triangular spacing and the rows are alternately three and four tubes wide. After leaving the convection section, the streams are joined and pass through a 6-tube shock section and then pass down into the radiant section. The 31-tube radiant section consists of two rows of tubes staggered so that the oil travels a zig-zag path down to the outlet at the bottom of the furnace. All tubes are 3½ in. OD by ½ in. wall. The convection tubes are 7 per cent chrome while the radiant tubes are 9 per cent chrome. Welded return bends are used throughout.

Fifty-six ceramic burners are mounted in each wall—each burner independently controlled, each cup projecting heat uniformly over an area overlapping the areas serviced by the adjacent burners. The type of burner as shown in the top of Fig. 2 is rated at 375,000 BTU per hour with a spud pressure of 6.2 lb. The gas is premixed with air by means of an air blower and an Askania ratio controller. The air-gas mixture is approximately 225 BTU per cubic foot when it issues from a spud at the entrance of the burner and entrains sufficient additional air to dilute the mixture to 100 BTU per cubic foot. This 100 BTU gas is thoroughly mixed and passes through 24 grooves around the ceramic tip of the burner. The 24 grooves issue radially into a ceramic cup. The cup is so shaped that the numerous small flames wipe the inner surface of the refractory plate and heat it to incandescence, at a reported temperature of 2400 F. As a result of this high cup temperature and intimate mixing, optimum conditions for complete combustion exist.

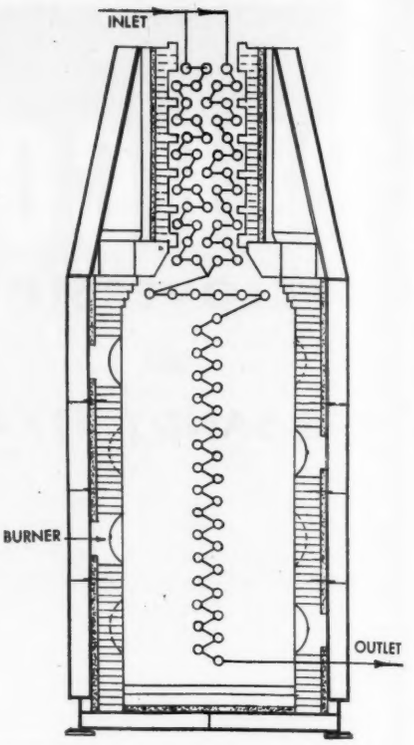


FIG. 1. Cross-section and flow diagram of radiant furnace.

The principal materials of the radiant cup burners are refractories. Material of the burner tip has to withstand a temperature difference over 2000 F from one end to the other. The material of the cup, being instantly and constantly in contact with the gas flame, must be of such quality as to be readily brought to incandescence, in order to produce the full effect of radiation shortly after combustion is started. These refractories have proved themselves durable and it is understood that tests are still being made to find a material that will withstand a temperature of 3000 F and higher.

Due to the simplified design and construction features, the various sections of the furnace are especially accessible for maintenance work. Due to

†Presented before the annual meeting, Western Petroleum Refiners Association, San Antonio, Texas, April, 1951.

*Refining department, Phillips Petroleum Company.

[1]Rickerman, J. H., "Transactions of the ASME," October, 1945.

[2]Mekler, L. A., and Van Fredersdorf, C. G., Petroleum Refiner, 26, 51-64, 1947.

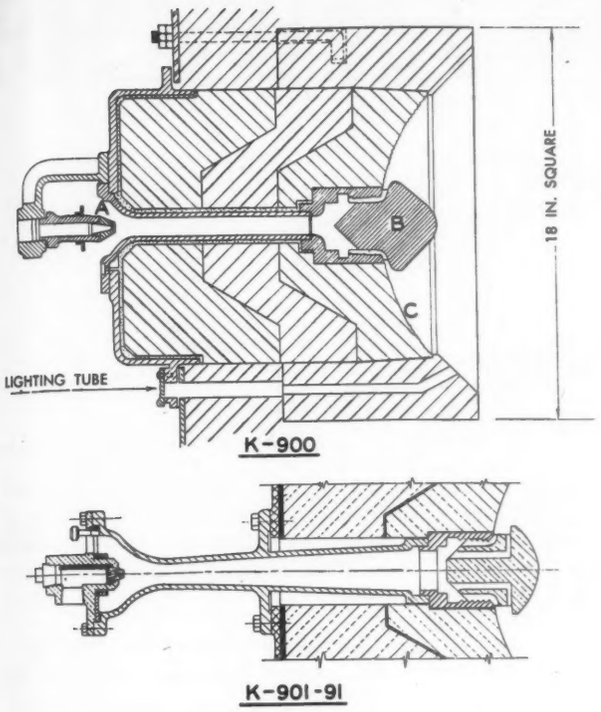


FIG. 2. Cross-sections of radiant type burners.

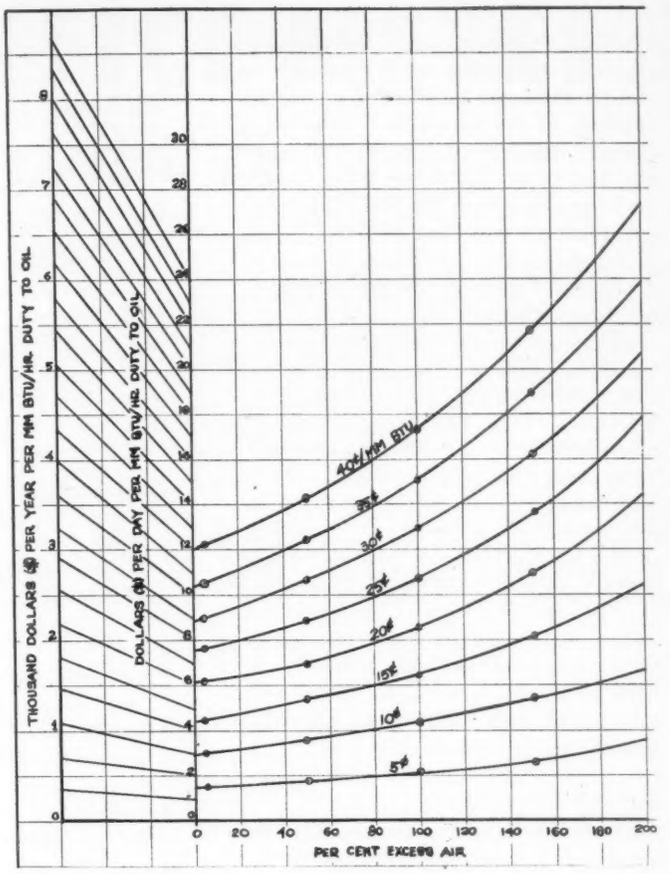


FIG. 3. Effect of excess air on fuel cost.

the fact that some idea of the coking limits had to be established for each charge stock, this furnace has on occasion been fired at extremely severe conditions. In spite of this, the original brickwork in both the radiant and convection sections is still in excellent condition, and no maintenance has as yet been necessary or is anticipated.

Furnace Operation

Since the start of operation every stillman who has had contact with the furnace is pleased by the ease with which it handles in variable high velocity winds prevalent in the Borger area; they have reversed their opinion that the smoothest furnace is the one which fires with over 100 per cent excess air.

The operation of the furnace has been followed closely and a typical test while cracking gas oil is shown in Table 1, which discloses:

1. Average radiant heat transfer rate is 17,000 BTU per square foot per hour.
2. Average convection heat transfer rate is 4,920 BTU per square foot per hour.
3. Heater efficiency—81.5 per cent.
4. Excess air in stack — 9.2 per cent.

The Orsat analyses were checked by running duplicate samples on a mass spectrometer. The tests disclosed that the east end of the furnace was operating with less than 1 per cent excess air while the west end was firing with about 15 per cent excess air, giving an average at the stack of 9.2 per cent. To account for the difference, it should be reported that the east end header box is completely sealed while the inlet and outlet piping as well as eight return bend thermocouples pass through the west header box. No attempt has been made to seal the opening. Sealing at these leakage points should further improve test results.

Firebox temperatures seldom exceed 1550 F even under severe firing rates. The temperatures at the bottom of the furnace are slightly higher than those at the shock tubes just below the convection section. This low box temperature combined with the low per cent of excess air present should reduce the oxidation of the furnace tubing and tube sheet material considerably. The economy of low ex-

TABLE 1. Radiant furnace test.

		Top	Bottom
1. Firebox temperature			
Maximum		1490 F	1580 F
Minimum		1390 F	1575 F
Average		1425 F	1580 F
2. Stack gas temperature		712 F	
3. Coil temperatures and pressures			
Inlet		117 F—790 psig	
Inlet 21st N		507	
Inlet 21st S		518	
Inlet 27th		648	
Inlet 35th		805	
Inlet 39th		875	
Inlet 45th		943	
Outlet		.... —500 psig	
58th tube skin temp.		1285 F	
4. Charge	121 B/H	33.8 API	
5. Fuel fired	39,400 CF/H	H/C—3.46	
6. Orsats: (Mass spectrometer samples)			
	Average of 14 samples		
CO_2	10.85		
CO	.20		
O_2	2.05		
N_2	86.90		
% "XS" air	9.2		
H/C	3.66		

7. Heat Balances based on gas side	
Heat released by flame	36.2 x 10^6 Btu/hr
Heat pick-up by oil in furnace	29.48 x 10^6 Btu/hr
Overall efficiency (LHV)	81.5%
Heat pick-up by oil in radiant box	22.2 x 10^6 Btu/hr
Average radiant rate	17,000 Btu/hr ft^2
Per cent of useful heat	75.3%
Heat pick-up by oil in convection bank	7.28 x 10^6 Btu/hr
Average convection rate	4,920 Btu/hr ft^2 (O.D.)
Per cent of useful heat	24.7%

cess air also shows up in the fuel bill. An approximation of the savings in dollars that can be effected by the reduction of excess air is shown for a specific furnace in Fig. 3. By reducing the excess air from 100 per cent to 10 per cent on a 30 MM BTU heater, using 15 cents per MM BTU gas, a yearly saving of $15,600 can be realized on gas consumption alone.

A new radiant cup burner of the totally inspirating type[1] has been developed and installed in several radiant heater installations in our refineries. This development has eliminated the air blower, Askania ratio controller, as well as the controls and safety devices necessary with air-gas premixing equipment. Operation of the totally inspirating burners has been very satisfactory. Contrary to my pessimistic predictions, the totally inspirating burners operated with no trouble at wind velocities as high as 40 miles per hour. A general view of both the totally and partially inspirating burners is shown in Fig. 4, two of the radiant heater installations at the Borger refinery.

Since the burners have no moving parts there is no maintenance problem. The burners light easily and burn uniformly and require practically no attention from the operator.

[1]Fig. 2. Burner K-901-91.

TABLE 2. Single-pass cracking of catalytic cycle oil.

1. Charge stock			
Gravity, °API	33.9		
Aniline point, F	156		
ASTM distillation			
IBP	436		
50 per cent	559		
EP	669		
2. Operating conditions	Radiant furnace		Box furnace
Coil outlet temperature	1025	...	920
45th tube temperature, F	948	934	....
Inlet pressure, PSIG	700	600	1100
Charge rate, B/H	100	100	300
Aniline point reduction, F	50	37	35
3. Yields, LV% of charge			
Gas, MCF/hr	51.9	32.7	....
Gasoline	31	28	22
Gas oil	41	54	57
Fuel oil(300 SFV at 122 F)	10	9	12
4. Gasoline quality (RVP—4.5)			
Research, clear	73	71	66
+ 3cc	86	84	80

The dampers and design of the stack breeching give excellent control of the draft. The draft is uniform in all parts of the furnace and there is no channeling of flue gases so that the flow of gases over the tubes is uniform.

The header boxes on both ends of the furnace are bolted on and give excellent sealing of air from the ends and are easily removed for access to the return bends or replacing tubes if required.

With all welded return bends the coil is easily adapted for burnout and decoking time is reduced to a minimum, which increases the actual on stream time of the unit.

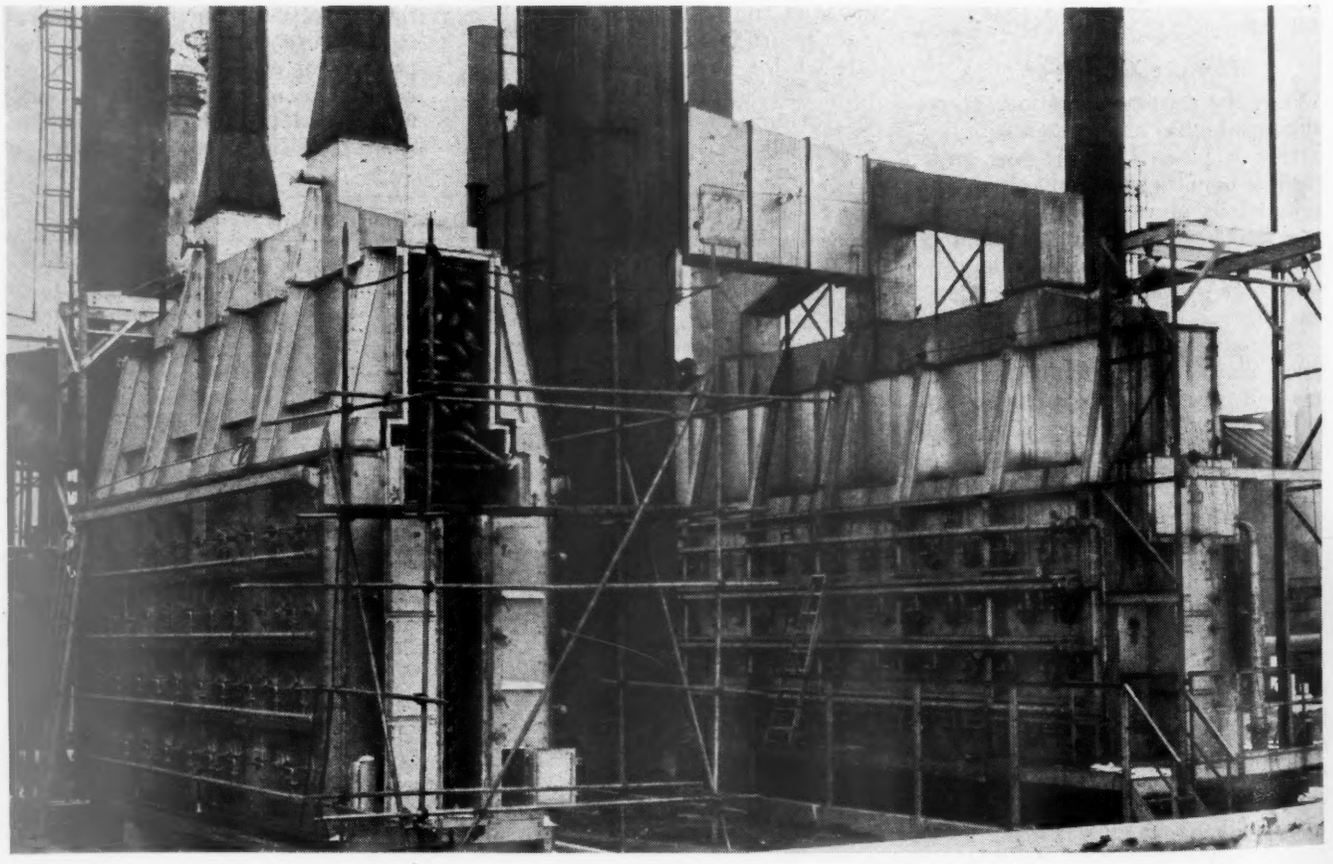
A split tube should cause little fire-box damage in view of low excess air.

All refractory in the furnace is readily accessible and easily removable so that replacements may be easily made.

Commercial Operating Results

Gas Oil Cracking. Although the radiant heater was purchased primarily for the visbreaking of a vacuum reduced topped crude, it was decided to start up on a light gas oil product from a once-through gas oil cracking operation. This was especially interesting since the same charge stock was being thermally cracked on a once-through basis in a box furnace designed and constructed in 1933.

FIG. 4. Two radiant heater installations at Phillips Petroleum Company plant, Borger, Texas.



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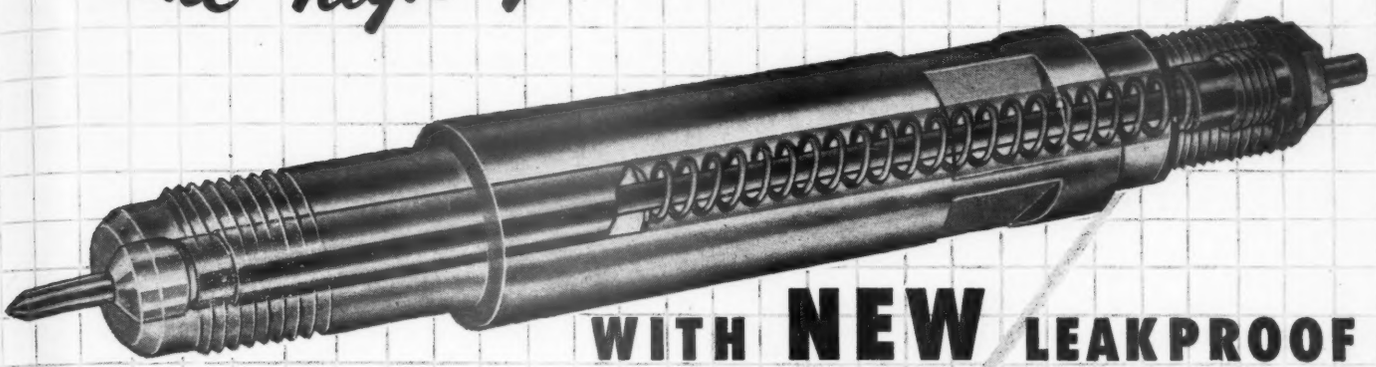

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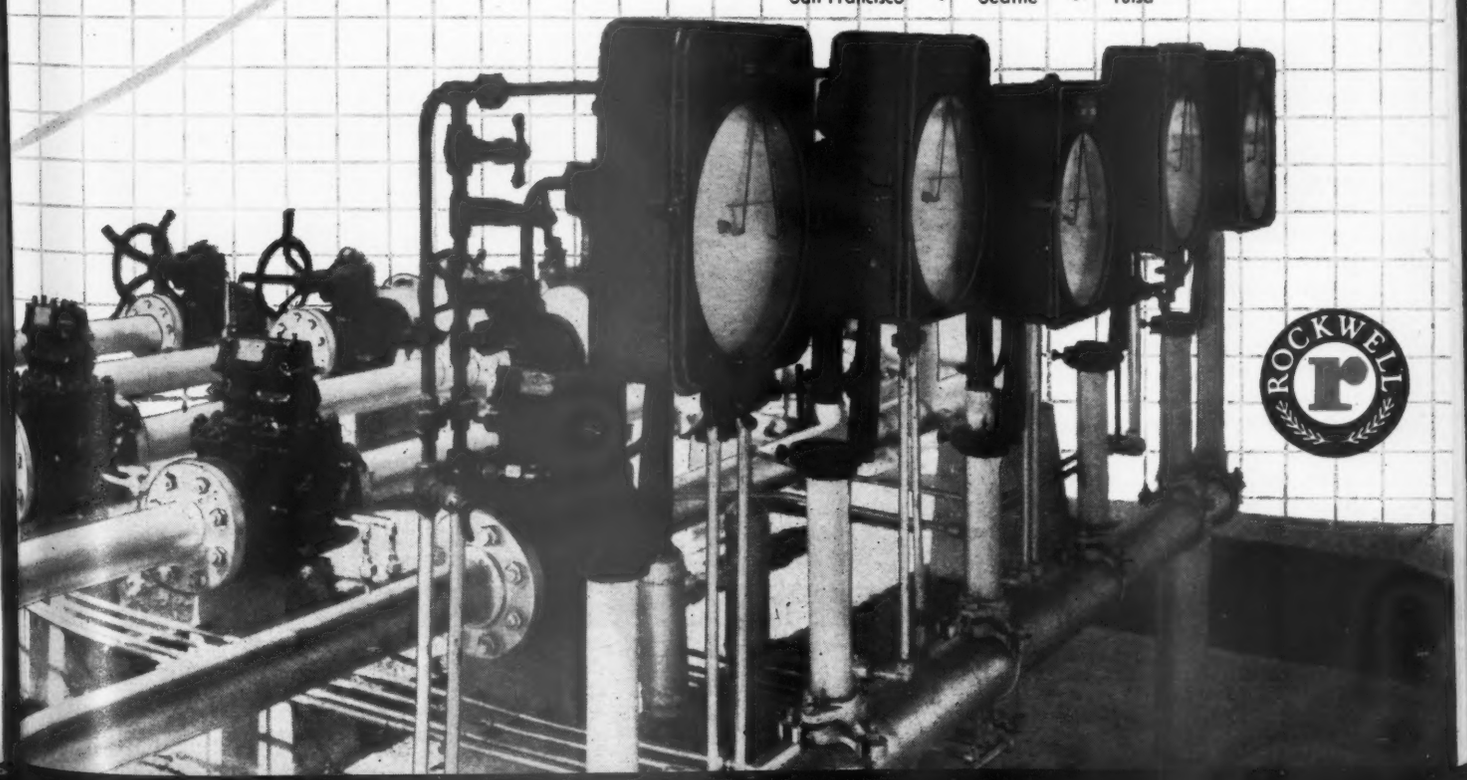


In general, it was found that on single-pass cracking of both catalytic cycle oil and virgin gas oil, the radiant heater obtained conversions (gasoline+gas) of 40-50 volume per cent and higher without excessive coil coking. In addition, the radiant heater yielded a gasoline having a research octane rating of four to six units higher than is normally obtained from thermally cracking a similar charge stock with the Borger refinery conventional heaters.

Table 2 shows the effectiveness of the radiant furnace in increasing cracking severity and improvement of gasoline octane ratings and yields over the old type box furnace. It was not possible within the coking limits on the box furnace to reach the conversion levels obtained on the radiant heater. Comparable trends in conversions and results have been obtained charging virgin gas oil stocks.

Visbreaking of High Vacuum Petroleum Residuum

The visbreaking of a heavy residuum from a high vacuum distillation process would normally be expected to be very difficult because of coil coking, but the processing of this type of stock through the new radiant heater was accomplished with excellent results. Visbreaking operations showed that fuel oil yields could be substantially reduced over those obtained by cutback of the vacuum residuum to fuel oil specifications. In addition, catalytic cracking feedstocks were produced resulting in increased gasoline and distillate yields. Details of the utilization of this heater for visbreaking a high vacuum residuum will be discussed in a paper to be presented at the Midwest regional meeting of the American Institute of Chemical Engineers at Kansas City, May 13-16, 1951.

The flexibility and degree of freedom available in controlling the shape of the time-temperature heating curve is utilized to its full advantage when visbreaking. A straight line time-temperature curve with no "tail" has been found suitable for this operation. Accordingly, the top row of burners on both sides of the radiant furnace is shut off and the last few tubes are fired hard to hold the heating curve to a straight line, thereby preventing the heat of cracking from flattening the curve. Heat transfer rates as high as 30,000 to 40,000 BTU per square foot per hour have been calculated for the last tube in the furnace.

By way of summation, it can be said that this type of radiant heat source gives the refiner a high efficiency furnace that is easily installed; has low maintenance and fuel costs; gives smooth operation with high wind velocities and is capable of successfully processing a wide variety of charge stocks, due to the flexibility in controlling the shape of the time-temperature curve. This selective heat input to the radiant coils produces higher heat transfer rates than in conventional heaters, thus saving initial tube costs, reducing residence time, allowing high vapor velocities and low pressure drop.

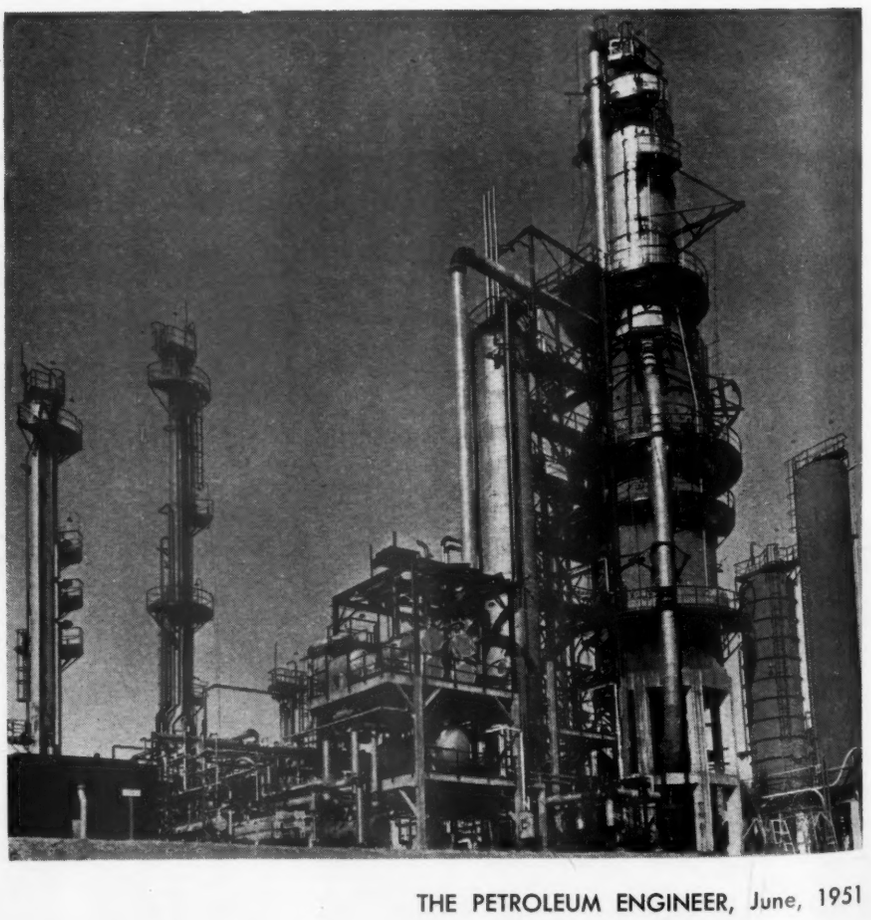
It has not yet definitely been established that maximum conversions have been reached while processing the various charge stocks.

The results obtained, however, have been so impressive that several additional radiant heaters have been purchased and installed. Based on present performance, this type of radiant heater has tremendous possibilities for both the large and small refiner, not only for the thermal cracking and visbreaking of gas oils, cycle oils, and heavy oils, but also for the thermal destruction of light hydrocarbons such as ethane, propane, etc., or other applications where short residence times are essential. * * *

Pan-Am Southern Corporation Dedicates Second Cat Cracking Unit

The first phase of Pan-Am Southern Corporation's five-year multi-million-dollar expansion program in the South was completed April 14, 1951, with dedication of a second catalytic cracking unit at its El Dorado, Arkansas, refinery. Dr. J. W. Bertetti, former manager of the refinery and recently named assistant manager of manufacturing for Pan-Am, pointed out that crude running at the refinery has been increased to 30,000 bbl per day.

The new cat cracker can process 9300 bbl per day of gas oil and is capable of burning 7000 lb of coke per hour. When operated in this way it refines 84,000 gal per day of high octane gasoline. It is one of the first units manufactured to employ centrifugal compression on both gas produced and the air required for burning the coke. The air compressor turns out 25,000 cu ft per minute, its turbine revolving at 5000 revolutions, twice the speed of a commercial airline engine. Some 180 tons of catalyst are used in the cat cracker, driven through at the rate of 13 tons per minute. Foster Wheeler Corporation designed and constructed the unit.



The modern instrument department is not only charged with the testing and maintenance of measuring and control instruments, but becomes a medium of demonstration for the education of operators.

The Instrument Department Grows Up

ROBERT F. ANGELL AND ROBERT TOBI

MANY papers have been written about instrument maintenance; the organization of an instrument department; what is necessary in the way of shop facilities in an instrument department, and what are the essential qualities and talents of an instrument man. Mostly, such writings have applied to restricted phases of the total problem, or to a particularly localized set of conditions. The purpose of this article, therefore, is to deal broadly with some of the more important considerations involved in organizing, building up, and running an instrument department.

Industrial instrumentation being relatively new, of course, decisions must frequently be based on experience and measurement engineering acumen rather than definitely established standards. We in the instrument profession are fortunate, indeed, to have as a means of idea exchange several fine technical groupings, such as the Instrument Society of America, the Southern California Meter Association, and there are others, now accumulating pertinent data and setting up much needed standards. These organizations are excellent, but nonetheless are not all sufficient.

There will be many times when the instrument department is required to weigh all the factors involved and arrive at important decisions without recourse to outside institutions or ideas.

Plant expansion and modernization with their related changes in equipment and process, have taken place too fast in the past decade for advances in instrumentation to keep apace. With this in mind, it should be worthwhile to pause and to re-evaluate existing procedures and general standards. These may have served their purposes adequately at the time of their development, and yet may be quite unsatisfactory now in the light of our increased knowledge and improved facilities.

In the early days it was deemed sufficient in most plants to have a sort of handy man around to make simple mechanical repairs on the then very limited number and variety of meters. But, as instruments became more diverse in their purposes, more efficient in performance, and much more numerous, the instrument men of necessity became more skilled, and the instrument department more an actual function of operation and less a loosely detached adjunct. It soon became obvious that instruments were an indispensable aid in many phases of manufacturing and processing and coincidentally it was conceded that the instrument man had graduated from his "handy-man" classification to the stature of a real technician.

Today the instrument department is a combination mechanical shop and laboratory, in which devices of endless variety are calibrated and kept in accurately functioning condition by skilled technicians. The work of the department involves the study and testing of new devices as well as the maintenance of those already in use. The instruments feature almost every known type of mechanical, electric, and electronic action, so it will be readily understood that the personnel must represent a diversity of skills and a broad range of understanding.

In simple fact, instrumentation is now so thoroughly an operational es-

EXCLUSIVE

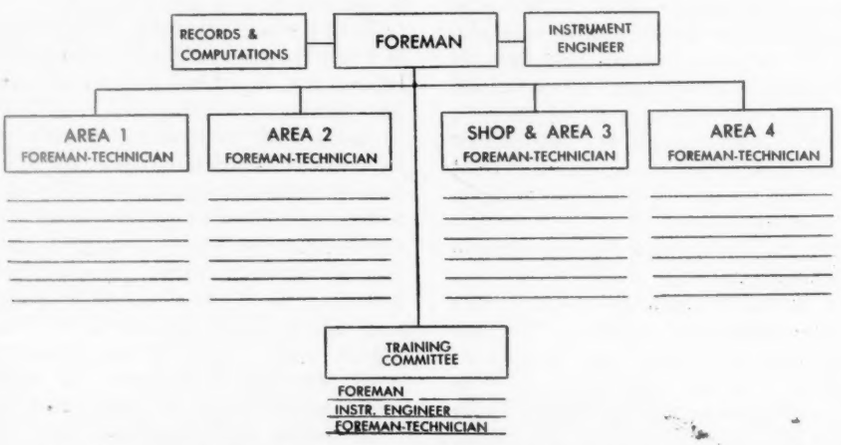
sential and has expanded to such dimensions, that the care and maintenance of measuring devices, recording instruments, and all the miscellany of gauges and controls that come under the scope of the word "instrumentation", are in themselves a major operation. It is not, as is often believed, merely a question of occasional repairs. Some of the other matters that are now functions of the department are preventive maintenance, selection of standards, planning of installations, field checking, keeping of records, instrument engineering, training in instrumentation techniques, testing new types of instruments, writing reports, maintaining stocks of spare parts, making mathematical calculations with data derived from tests, and making recommendations as to new devices and new applications.

It is accepted that all this work is urgently required, and the instrument department, being especially equipped and manned, can do it most efficiently so, of course, is the logical choice. Just how large such a department should be and exactly how it should dovetail into existing operations are individual problems for each plant. At the Los Angeles refinery of Union Oil Company of California, the activity is headed by the instrument department foreman, who reports directly to a master mechanic. The latter in turn is responsible to the assistant chief engineer, the active head of the maintenance group and a part of the engineering division. The internal set up of the department, which functions in close cooperation with operating, process, laboratory, and engineering units, is shown in the accompanying organization chart.

It is believed that, in almost any kind of plant, the instrument department should be more than an operational entity. It should be educational. In other words, the personnel should become a specialized force in all aspects of measurement and control so that it can give technical advice and aid to other interested groups and departments. It should be in a position to select, test and install, even the newest type instruments, and hence must keep itself apprised by every available means of current and pending development in the instrumentation field. At the same time, of course, it must be capable of keeping such instruments as are already in use functioning properly, and here is one of the many known reasons for the closest kind of understanding and cooperation between the instrument specialist and the operator. The ideal toward which the former should strive is to so acquaint the operator with the mechanism and modus of his instruments that there will be fewer calls on the department.

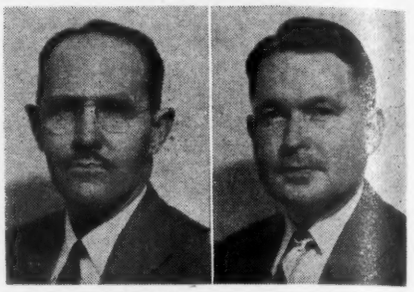
As a matter of fact all phases of design, construction, process engineering, and operation, particularly in such technical plants as petroleum refineries, are so inseparably related with and dependent upon instrumentation that they simply can no longer be considered apart. There must, therefore, be constant consultation and conference between the various groups in order that the maximum in efficiency and productiveness may be achieved. By the same token, the scope of instrumentation is so rapidly expanding, and so many changes and new developments are taking place that the instrument specialists will do well to make frequent overall surveys in consort with the various groups that they serve to make sure that no significant discovery or application is being overlooked.

The problems of one instrument department are many and varied, but following are a few typical questions and answers that may be of help to our readers in solving their own problems:



SAMPLE OF AN ORGANIZATION CHART

THE AUTHORS



Robert F. Angell Robert Tobi

Robert F. Angell is instrument department foreman at the Los Angeles refinery of Union Oil Company of California, at Wilmington, California. He has been with the department since its inception some 25 years ago, and has helped it grow into an essential and highly important phase of refinery operation.

Robert Tobi is an instrument engineer with the Burke and Reynolds Construction Company, and is also associated with Union Oil Company's Instrument Department. In addition, he is instructor in instrumentation at the Los Angeles Harbor Junior College at Wilmington, California. This incidentally, is perhaps the first course of its kind ever given in a college, and marks another important step in the general recognition of instrumentation as an indispensable industrial aid.

---

1. How accurate must the instruments be?

There are a number of factors that influence this. Normally it will be determined by the type of operation the instrument controls, and if a plant control device its limits will be set by the engineering department. If it is a metering device its accuracy may be a function of the cost of the commodity being measured. In general, however, a commercial accuracy of 98 per cent is sufficient for plant measurements, but there are plenty of exceptions. Many temperature indicating or recording instruments must be accurate to within 0.25 per cent.

2. Should one standardize on an individual make of instrument?

Standardization is good, because it cuts down the variety of parts that must be carried in stock and consequently keeps down maintenance costs. It also simplifies the work of the instrument men and the operators in the areas they serve. Standardization too rigidly applied, however, can restrict advancement. It is our practice to choose the best in each line for each specific purpose, and to standardize as between areas.

3. Is it advisable to standardize on pressure gauge sizes and ranges?

This again depends on the application. We have selected 4½-in. for "run of the mill" gages on pumps and other equipment throughout the plant. These gages are in and out of the shop, so are in rotating service. We have standardized on steel tube gages of a certain make, and carry 8 differ-

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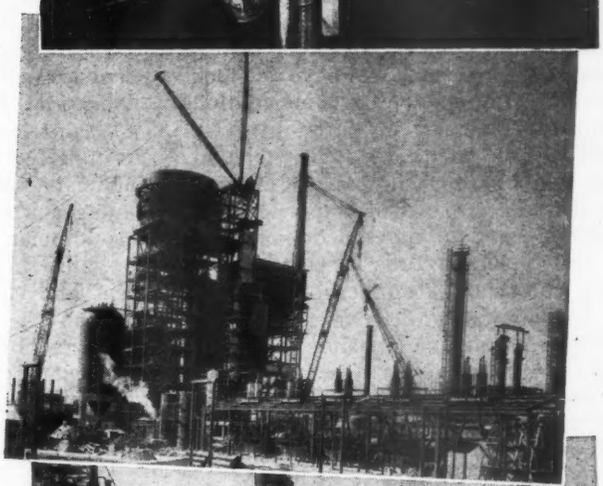

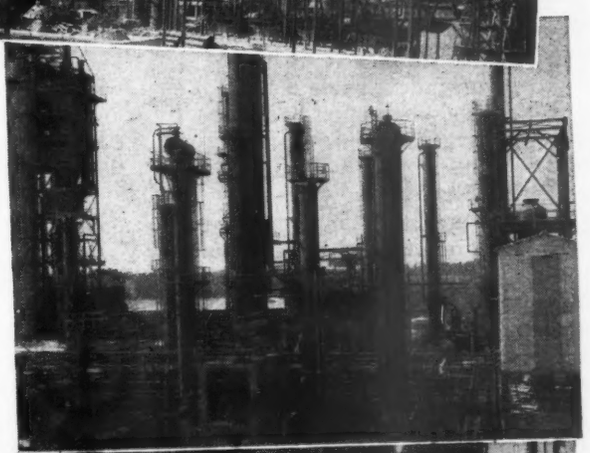

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ent ranges in our refinery warehouse. For mounting on panels or instrument boards, gages are ordered for each particular job. They are usually the 6-in. flush-mounted type. We do not carry spare parts for these special instruments but do carry a small stock of repair parts for the 4½-in. gages.

4. Should instrument parts be carried in stock and who should be responsible for stock maintenance?

We believe it is necessary to have instrument parts or complete replacement instruments on hand for all continuous process plants. For most effective service the parts should be stored and controlled by the instrument department. We have a stock room with suitable accommodation for the diversity of parts involved. Experience dictates what parts should be kept in stock, how many of each kind, and also which complete units should be maintained in duplicate.

5. Should records be kept, and if so, who should keep them?

An instrument department can definitely reduce maintenance costs and give better service by means of records, and the instrument department is best qualified to keep such records. Following is a partial list of files that can be very helpful:

a. A well indexed data file.
b. A good instruction book file.
c. A parts list file.
d. An instrument companies' catalog file.
e. Instrument installation records.
f. Data on preventive maintenance and shut down schedules.

In our instrument department installation records are found to be of the greatest importance. We keep an account of every installation excepting simple indicating temperature and pressure gages. In these folders are retained all calculations, drawings, specifications, installation data, and other pertinent facts.

6. Should installations be numbered and designated?

When dealing with a hundred instruments or less, this is perhaps unnecessary. In our refinery we use standard designations and numbers for each installation. These are carried on all folders in the entire record system. They provide a means of ready reference, and help to keep the instruments themselves and the records properly identified.

7. Are specialists necessary in an instrument department?

The larger the instrument department grows, the more need for specialization. This is true in all types of occupation and craftsmanship. The aptitude for specialized performance should be recognized and where advantageous should be encouraged by the foreman. It is not possible to specialize in all phases of measurement and control because the work just can't be divided that way. Much of the maintenance and repair of instruments is sporadic in nature and neither its volume nor character can be predicted. In most instances, therefore, it will be found more efficient and economical to use a proportion of the men on shift and standby work, and to employ the specialists also to educate other men in the instrument department.

8. Should operators repair instruments?

It is our belief that operators should not attempt to repair instruments, but again it is necessary to make exceptions. In emergencies, for example, the operators ought to be able to take such steps as are necessary to protect their plants. But, to reduce "tinkering" with instruments, they must be kept in good shape always so that the operator will have no occasion to "get inside" of them. Actually, the operator should be in about the same position as an aviator. The latter concentrates on flying and his success as a pilot depends on his technical skill and the efficiency and accuracy of the instruments before him. It is not his responsibility, excepting in an emergency, to repair the instruments.

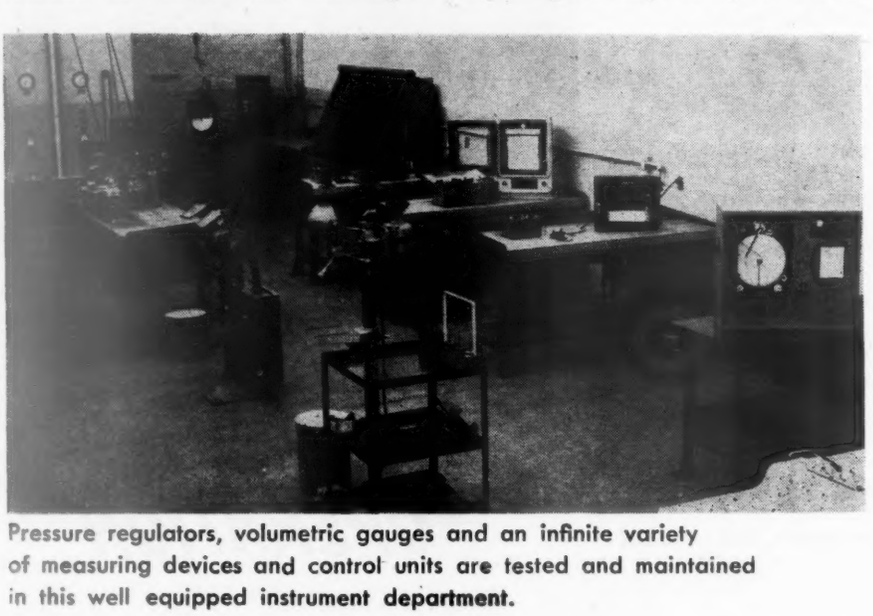
9. How is maintenance procedure decided?

Preventive maintenance is pretty generally conceded to be the best means of insuring continuous effective operation of equipment. It is, however, not possible to establish any regular schedule of maintenance effort without a backlog of experience. With machinery, properly timed lubrication is an almost certain guaranty of continuous performance. Simularly, the replacement of batteries in potentiometers and other electrical measurement and control devices is ordinarily enough to keep them functioning without interruption. These more or less mechanical measures, however, are not sufficient as instrument maintenance. Experience has shown that identical instruments on different applications may react differently and each require separate scheduled maintenance programs.

In our refinery most preventive effort is expended during plant shut downs. At these times, as far as possible, all electronic amplifiers are checked. Many thermocouples and wells are checked, and replaced if experience indicates that they should be. On some of the more critical installations, thermocouples are changed during every shut down, regardless of their condition. And all vital equipment is serviced whenever a shut down permits.

An individual instrument man in charge of a plant will automatically develop a service schedule, and on a larger scale, a supervisor with 3 or 4 assistants can even develop a complete routine from a study of written and verbal reports. Also, it may be pointed out that by observing aptitudes and putting the right man on the right job, the foreman can increase the usefulness of the individual, and hence improve the general efficiency and economy of the instrument department.

That, in the last analysis, is the ultimate aim of an instrument department—to render prompt and effective service to the operating and related groups, to the end that through logical application of available instruments, the plant may be safe, productive, adaptable, and economical. * *



Pressure regulators, volumetric gauges and an infinite variety of measuring devices and control units are tested and maintained in this well equipped instrument department.

ALKYLATION PLANT IMPROVEMENTS

New types of tube bundles and contactors facilitate redesigning of alkylation units employing both HF and H_2SO_4 as catalysts.

D. H. PUTNEY*

THE years 1940 through 1945 witnessed the development of alkylation from a laboratory process to an industry of enormous capacity for the production of aviation gasoline. During those years the push for more and more installed plant capacity led toward standardization of plant designs and away from experimentation or design changes. The years 1946 through 1950 saw a decline in the demand for alkylate and little incentive for spending money to improve the process or increase the capacity of existing plants. With the demand for alkylate again rapidly increasing it is fitting that a critical study of existing plants be made to determine how best to increase production, also to carefully design any new installations guided by experience of the past 10 years so that the required quality and capacity are obtained at minimum cost and with the minimum amount of steel, labor, and time. To assist in such study is the purpose of this article.

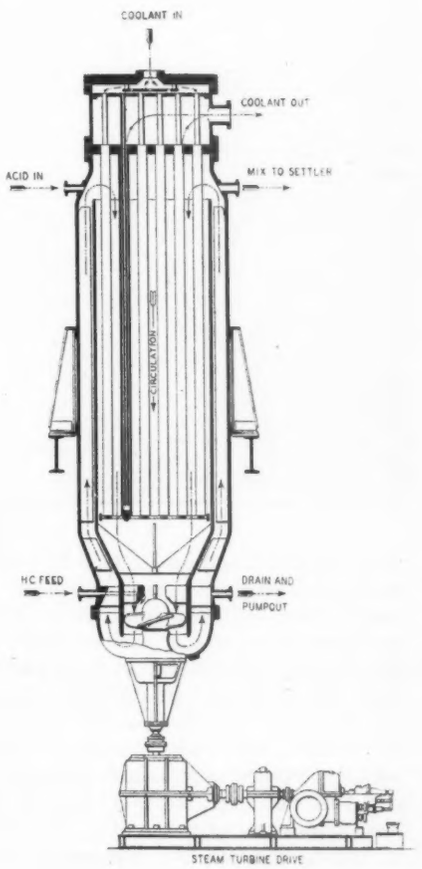
With a huge defense program in the making, a new aviation gasoline situation has arisen. Not only must the refining industry be in position to supply enormous quantities of aviation fuel but it must be able to produce this fuel to specifications much higher than during World War II. Advances in aircraft engine design now make it necessary to supply a major portion of the aviation gasoline as 115/145 grade. The components of this grade are principally isopentane, alkylate, and aromatics. The blending of 100/130 grade aviation fuel normally requires only from 25 per cent to 35 per cent alkylate, and considerable alkylate produced from olefins other than butylenes may be used. In the blending of 115/145 grade however, from 70 to 80 per cent alkylate is required and this alkylate must be of high quality in order to meet the 145 rich mixture index. Such alkylate must be produced for the most part from butylenes, although as aromatic blending components become available more propylene alkylate may be worked into the blends. In all cases, however, it is desirable to improve the octane rating of the alkylate so that it will make a greater quantity of finished blend.

With both increased quantity and quality of alkylate required to meet our defense demands it is evident that not only must new alkylation plants be built to ultilize available feed stocks but also the existing units should be altered or "modernized" to step up the quality and/or quantity of alkylate where this can be done without large capital investment. Recent process and mechanical studies of alkylation plant reactor sections have disclosed a number of ways in which new alkylation plants may be built better and at lower cost than previous units, and ways in which existing reactor sections may be modified to increase capacity and/or quality with moderate capital outlay. These improvements apply to both the sulfuric acid and the hydrofluoric acid processes. To avoid possible confusion the two processes are discussed separately in the following:

HF Alkylation

Improvements in Existing Plants. All existing commercial HF alkylation plants are equipped with contactor reactors constructed as shown diagrammatically in Fig. 1. There were 78 of these reactor units installed during World War II. A few have been dismantled but the great majority are either now operating or could easily be rehabilitated and placed in service. Most of these units are water cooled, as shown in Fig. 2, while a few are equipped with mechanical refrigeration, as shown in Fig. 3. All of these plants were built in the haste of getting the World War II aviation gasoline program under way and they were all under construction before appreciable data and experience were available from the first commercial units. It was thought at the time the units were designed that a reaction time of about 20 minutes was required for HF alkylation similar to that required in the sulfuric acid process. Now, however, it is recognized that 8 to 10 minutes is ample time to complete the reaction. It therefore becomes possible to put 2 to 2½

FIG. 1. Vertical contactor, lance type tube bundle.



*Vice president, Stratford Engineering Corporation.

EXCLUSIVE

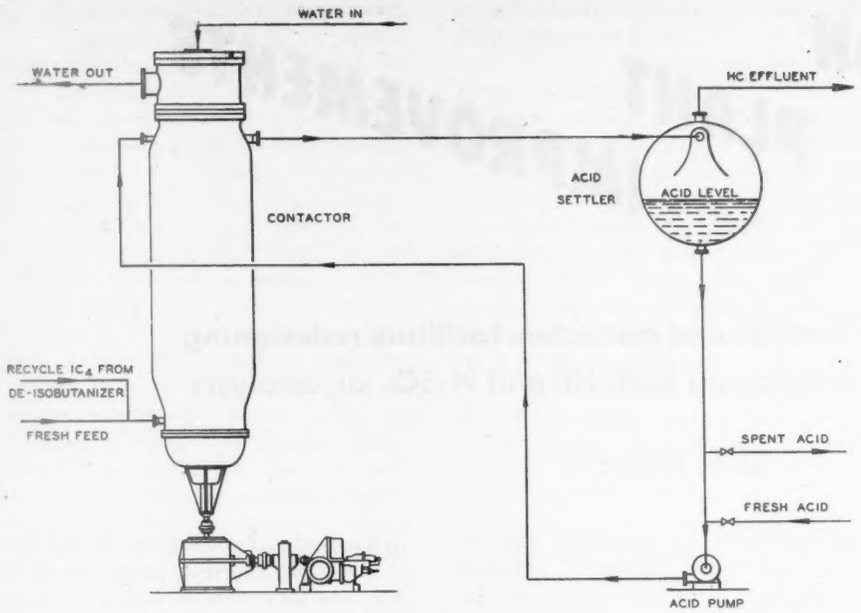


FIG. 2. Alkylation unit—water cooled.

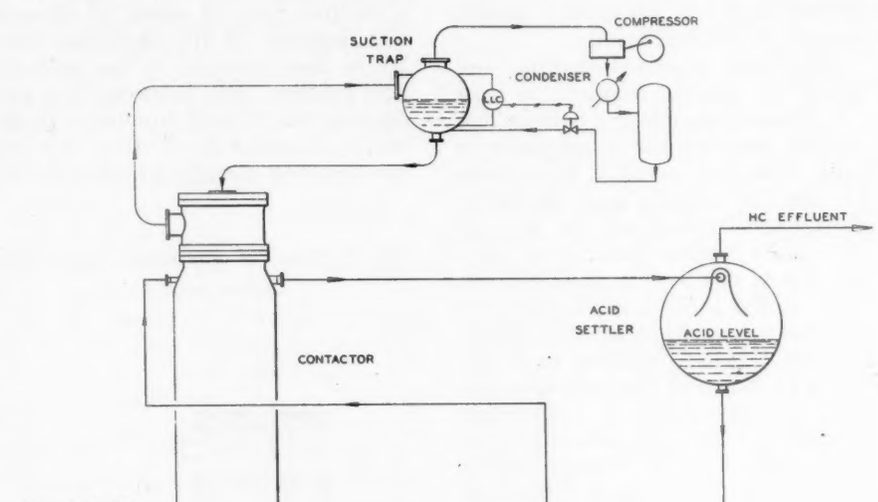


FIG. 3. Refrigerated unit, lance type tube bundle.

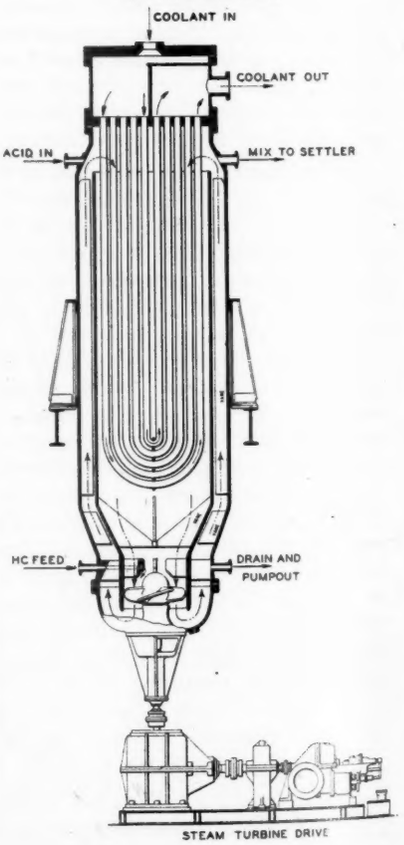
times as much composite feed to most of the existing reactors and still have ample reaction residence time. The problem becomes one of heat removing capacity since such an increase in feed rate will also increase the load on the contactor tube bundle by 2 to 2½ times. The tube bundle with which the units were originally equipped will not take such an increased load without a corresponding increase in mean temperature difference between the coolant and the reaction mix.

To make possible the increase in capacity of the reactors without increase in reaction temperature a new type tube bundle has been developed as shown in Fig. 4, which is capable of removing over 2½ times as much heat with the same mean temperature difference as the original tube bundle. The small contactor reactor, known as Size 30, which has an internal circulation rate of 30,000 gpm, was originally equipped with extended surface finned tubes having a total surface of about 4800 sq ft and a transfer rate of 25 for water cooling. The newly developed tube bundle as shown in Fig. 4 consists of all prime surface in amount of 4100 sq ft and shows an overall service transfer coefficient of 90 for water cooling. The new type tube bundle for the large contactor, known as Size 50 and having 50,000 gpm internal circulation, consists of all prime surface in amount of 6600 sq ft and also shows a transfer rate of 90 for water cooling as compared to the original finned tube bundle having 7700 sq ft of extended surface and showing a transfer rate of only 25.

All the new type bundles for both sizes of contactors consist of U-tube elements constructed of 1 in. OD No. 11 BWG seamless tubing without welds or joints except where rolled into the tube sheet. The elimination of all welded joints and welded plugs in the tube bundle elements is a definite advantage as nearly all of the tube failures in the past have occurred at welds.

Aside from the ability of the new type U-tube bundle to make possible a large increase in capacity for existing contactor reactors there is its ability to lower the reaction temperature

FIG. 4. Vertical contactor, U-tube bundle.



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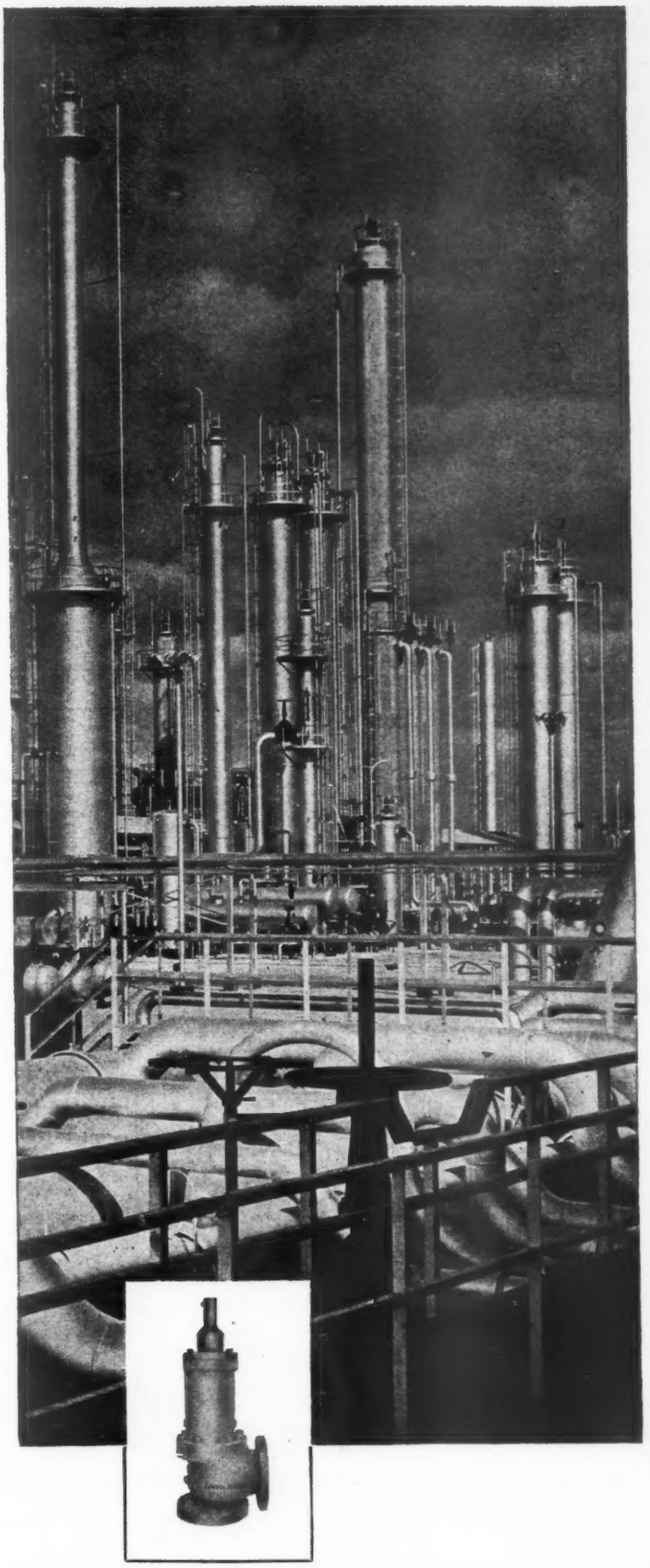

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in cases where the feed rate is either not increased or is increased to less than 2½ times the original feed rate. In units where the feed rate remains as originally designed the new tube bundles will remove the heat with a mean temperature difference of only about 40 per cent of the original design figure. This is of particular significance in the light of recent findings that as the reaction temperature is decreased in the HF alkylation of butenes, the F4 rich mixture index number of the alkylate is increased, at least in the operating range from 110 F down to 60 F.

On present water cooled units where the application of mechanical refrigeration is being considered to further decrease the reaction temperature, the new type bundle offers a means of reducing capital investment costs and operating costs in the refrigeration plant. The original tube bundles with finned tubes realized a service transfer coefficient of only 20 on propane refrigeration applied to the 4800 sq ft of extended surface in the Size 30 contactors and 7700 sq ft in the Size 50 contactors. The new type bare U-tube bundles show a service transfer rate of 60 on propane refrigeration applied to 4100 sq ft of bare surface in the Size 30 contactor and 6600 sq ft in the Size 50.

The U-tube bundle is interchangeable with the original bundle. Existing channel and channel cover can be used by simply installing a baffle plate in the channel. Where water cooling is used this is the only change required. In cases where mechanical refrigeration is to be used it is necessary to pump the refrigerant through the tube bundle as shown in Fig. 5. A number of manufacturers offer standard pumps for this service, circulating a large quantity of refrigerant at very low head and requiring only about 3 to 5 hp per contactor. The original finned lance type tube bundle required no refrigerant pump since flow could be established by the difference in density of the down-flowing all-liquid refrigerant stream in the lance tubes and the up flowing vapor liquid mixture in the annular spaces between the lance tube and the finned outer tubes.

New HF Alkylation Reactor Systems. The original HF alkylation contactors with which all plants built during World War II were equipped were vertical units as shown in Fig. 1. These contactors required considerable structural steel for support and for servicing. The amount of this structural steel approximated 30 tons for a single Size 50 contactor or 50 tons for a two Size 50 contactor plant. Moreover, the drives of these machines involved the use of both parallel shaft reducing gears and right angle gears. This necessitated the setting and alignment of four pieces of machinery — contactor, right angle gear, parallel shaft gear, and turbine.

The new type contactor is a horizontal machine as shown in cross section assembly in Fig. 6. It is mounted directly on a concrete foundation in steel saddles that are made a part of the contactor shell. The only structural steel required is a small amount in the form of trolley beams and their supports for use in pulling or reinserting the tube bundle at one end of the contactor and for removing the hydraulic head at the other end. To install this servicing steel permanently for each contactor requires only about 7 tons per machine for the Size 50 and 6 tons per machine for the Size 30.

The drives for the horizontal contactors are greatly simplified. In the case of motor driven units gears are eliminated and the drive is by means of an explosion proof motor directly connected to the contactor shaft through a flexible coupling. Drive for the Size 30 contactor is a 900 rpm motor, and for the size 50 a 514 rpm motor. In the case of turbine driven contactors it is of course necessary to employ reducing gears for best turbine efficiency, but these are simple parallel shaft gears and the right angle gears used on the old vertical units are eliminated.

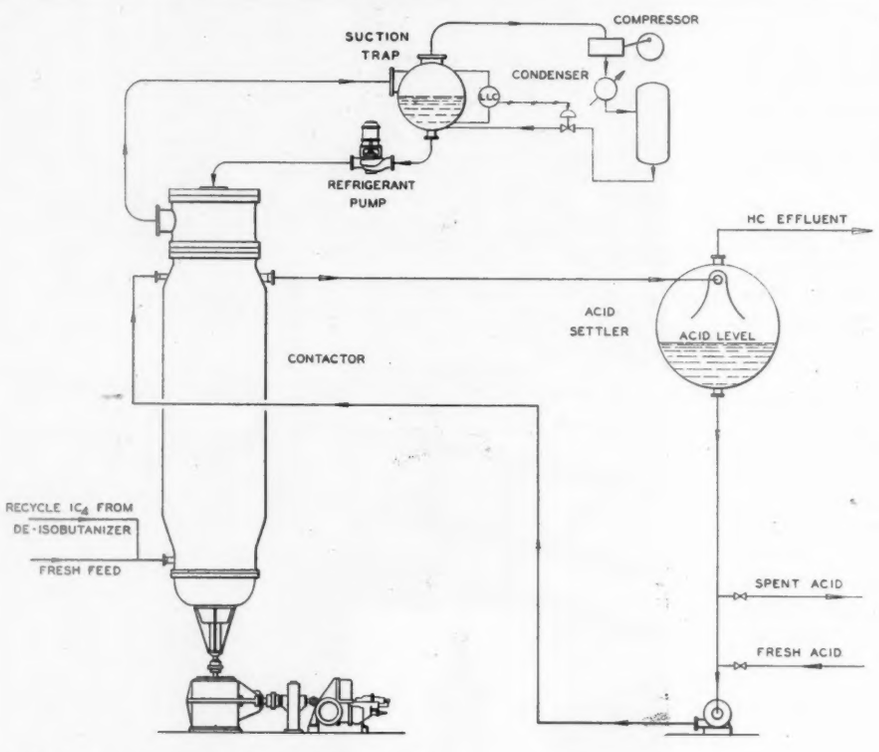


FIG. 5. Refrigerated unit, U-tube bundle.

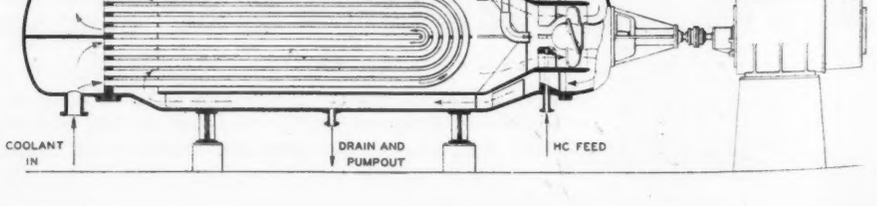


FIG. 6. Horizontal contactor.

Not only is the equipment cost of the new type contactor and drive considerably less than the old vertical type unit but there is also a considerable saving in erection costs. Foundations need not be spread to the extent required for the previous tall structures with wind loads. About 18 to 23 tons less structural steel are required for each Size 50 horizontal contactor and there is no structural steel requiring fireproofing. There are only two shafts to align instead of six. Piping is shortened and simplified by all being at low elevation. For units with mechanical refrigeration the suction traps are mounted above and supported on the contactor shells. No refrigerant pump is required as thermo-syphon flow can be established in the U-tube bundle when it is in horizontal position. There is even the possibility of eliminating the acid circulating pumps by elevating the acid settler and introducing the acid return line from the settler at the suction side of the contactor impeller. The total of all these savings in equipment, erection time, and erection costs not only represents a considerable sum of money but it also means a considerable saving in tonnage of steel required at a time when steel conservation is necessary.

Sulfuric Acid Alkylation

Improvements in Existing Plants. There were 64 alkylation contactor reactors built for sulfuric acid catalyst during World War II, most of which are now in operation. All of these are of the general type shown in Fig. 3. It is necessary when employing sulfuric acid as the catalyst that operating reaction temperatures be held in the range of 40 to 60 deg and therefore all such units are refrigerated. Some use ammonia as the refrigerant, a considerable number use propane and a few use isobutane.

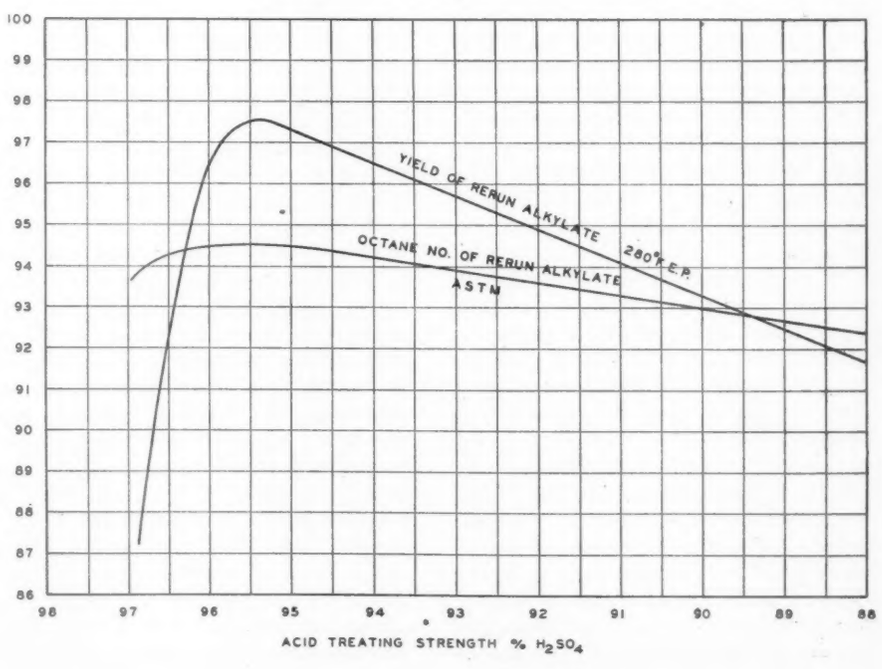
The contactors in all of these units were originally of the type shown in Fig. 1, although some of them are now being modernized with new high capacity tube bundles as illustrated in Fig. 4 and with refrigerant pumps installed as shown in Figure 5. The U-tube bundle for sulfuric acid contactor reactors is the same as described previously for hydrofluoric acid service. It will provide 2½ times the heat removing capacity of the original extended surface tube bundle for the same MTD or will take care of the same heat removal for only 40 per cent as much MTD as the original tube bundle. This makes possible a higher suction pressure to the refrigerant compressors and an increased capacity of existing refrigeration units, provided auxiliary equipment is of ample size.

Some of the existing sulfuric acid alkylation units that include more than one contactor are operating with all contactors discharging acid-hydrocarbon mix into one common settler and recycling acid from this settler to each of the contactors. The acid strength in all contactor reactors is thus at the same level. Such an operation can be improved by the installation of an additional settler or settlers or by the division of the existing settler into separate settling zones so that the acid strength can be carried at a different level in each settler. For example, take the case of a plant in which two contactors are operating with a single settler on butene alkylation, where fresh acid is fed at 98 per cent strength, where the recycle acid is carried at 90 per cent strength and where the rerun yield of 280 F end point aviation alkylate is 93.3 per cent of 93.0 ASTM octane. If separate settling zones are provided for the effluent mix from each contactor and the recycle acid from each settling zone is returned to the contactor from which it came, then the acid strength in each of these two contactor-settler systems can be carried at a different level. In the first zone the acid can be fed at 98 per cent H_2SO_4 and maintained at a level of, say, 94 per cent H_2SO_4. The spent acid from this first contactor-settler system at 94 per cent strength becomes the feed to the second contactor-settler system where it is spent down to 90 per cent H_2SO_4 and then discarded from the plant. Both contactors are operated in parallel on both butane-butene feed and recycle isobutane. The alkylate that is made in the system operating at the 90 per cent H_2SO_4 level will be the same in both yield and octane as it has previously been, but that half of the alkylate made in the system operated at the 94 per cent H_2SO_4 level will show an increase in rerun yield of approximately 3.2 per cent and an increase in ASTM clear octane of about 1.2 points. With three or more contactors, each with separate settling zone, the overall improvement is even greater. The curves shown in Fig. 7 show the effect of recycle acid strength on ASTM octane and rerun yield of 280 F E.P. aviation fraction from a typical case of butene alkylation with all other operating conditions remaining constant.

New Sulfuric Acid Alkylation Reactor Systems. The latest design of contactor-reactor for sulfuric acid alkylation plants is as shown in Fig. 6 with bare U-tube bundle and with acid inlet at the suction side of the impeller. For an installation requiring only a single contactor it is connected to auxiliary equipment as shown in Fig. 8. For installations large enough to warrant more than one contactor each contactor is provided with its own settler in order to take advantage of multistage acid operation as described in the preceding paragraph.

Such a unit offers a number of economies as compared to the original vertical type unit. As noted previously

FIG. 7. Effect of acid strength on yield and octane.



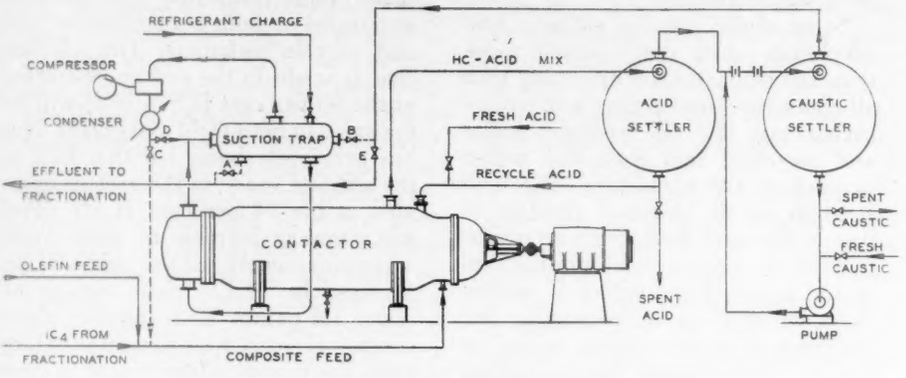


FIG. 8. H_2SO_4 alkylation unit.

under the description of the latest type HF units these horizontal contactors require no steel supporting structures. The drive is by means of a direct connected explosion proof motor with all driving gears eliminated. The suction trap is supported on the contactor shell by means of saddles. Connecting pipe lines are shorter and the piping is simplified by being closer to ground level and by the elimination of the acid recycle pumps. By elevating the acid settler a few feet the recycle acid is returned from the settler to the contactor without the use of a pump. The differential pressure across the contactor impeller runs about 5 psi. The mix outlet from the contactor is taken from the discharge side of the impeller on the upstream side of the contactor tube bundle. By returning the recycle acid from the settler to a point on the down-stream side of the contactor tube bundle at the suction side of the impeller, a major portion of this 5 lb differential is available for taking care of the pressure drop across the recycle acid control valve and friction loss in the line. Moreover, with the settler elevated additional pressure is available by reason of the difference in gravity between the HC-acid mix in the line to the settler and the recycle acid only in the acid return line.

A unit of this type for alkylating propylene or mixed feeds is ordinarily installed and operated without the dotted lines shown in Fig. 8. The refrigeration cycle is operated as a closed system, heat being removed indirectly from the reaction zone by exchange through the contactor tube bundle. Change in composition of the feed stock does not affect the refrigeration cycle and no isobutane is evaporated from the reaction zone as in the case of units cooled by self-evaporative refrigeration. Such a system can handle a great variety of feed stocks including propylene and the usually attendant appreciable quantities of propane without disadvantageously upsetting the operation of the refrigeration cycle.

A recommended method for installing new reactor systems is to incorporate the bypass lines indicated by dotted lines in Fig. 8 and containing valves lettered A, B, and C. The refrigeration compressors are designed and rated for using isobutane as the refrigerant. When the olefin feed contains appreciable quantity of propane or a high percentage of normal butane then the refrigeration system is operated as a closed system on isobutane, valves A, B and C being closed, and valves D and E being open. When the unit is to operate on a feed stock containing low percentages of propane or other diluent then valves A, B, and C are opened while valves D and E are closed. In this way all the hydrocarbon effluent from the settler is passed through the suction trap, is chilled by the evaporation of isobutane therefrom and used as the cooling medium in the contactor tube bundle. The liquid effluent from the suction trap becomes the feed to the deisobutanizer tower, which then operates at greatly reduced overhead load. The isobutane evaporated in the suction trap and in the tube bundle is compressed, condensed, and returned to join the composite feed to the contactor. As all of the isobutane recycled in this manner passes completely through the reaction zone and settler it has the desirable effect of greatly increasing the external isobutane-olefin ratio, which is recognized as of major importance in making for high yield and quality of alkylate as well as for low acid consumption. If, for example, with a feed stock as described, the isobutane recycled through fractionation makes for an isobutane-olefin ratio of only 3 to 1 and if the refrigeration compressor condensate is also recycled to the contactor, the net result is a composite feed containing isobutane in amount of between 8 and 9 parts to each part olefin. None of this isobutane is evaporated from the reaction zone as in the case of self-refrigerated reactors, and it is therefore just as effective in promoting good alkylation conditions as it would be had it been recycled through fractionation at extra cost.

Improvements in Sulfuric Acid Alkylation. During the past 10 years considerable study and pilot plant work has been done on a two stage alkylation process consisting fundamentally of a primary absorption stage wherein the olefins from a hydrocarbon mixture are absorbed in recycle alkylation acid, and a secondary alkylation stage wherein isobutane is alkylated by this olefin-acid mixture. There is no full scale commercial application of this process to date but it has three distinct advantages for future consideration.

First, it makes available for alkylation the large quantities of propylene (and some butenes) present in refinery tail gases. In most refineries these olefins are being burned with the tail gases because their concentration and recovery by conventional means would not be a profitable operation. When more alkylation feed stocks can be utilized the absorption of these olefins becomes economically attractive.

Second, the two stage alkylation process makes it possible to eliminate most of the diluent normal paraffin hydrocarbons (propane and butane) from available liquid hydrocarbon feed stocks. The deleterious effect of these diluents in an alkylation system is well known and where alkylate quality must be improved the process provides a means for so doing by absorbing the olefins from the feed in recycle acid, passing the remaining normal and isoparaffins to fractionation, and alkylating isobutane with the olefin-acid mix from the absorber.

Third, with practically all propane and normal butane eliminated from the alkylation zone as described above the application of effluent refrigeration as shown by dotted lines in Figure 8 becomes very attractive. The vapors from the suction trap will be largely isobutane. When these are condensed and returned to the reactor feed the external isobutane:olefin ratio will be increased 5 to 7 points. It is unnecessary to take this refrigerant condensate through fractionation. All of it passes through the entire reaction zone and none is vaporized therefrom as in the case of units cooled by self-refrigeration. Evaporation occurs in the tube bundle and suction trap after the alkylation reaction is complete and the hydrocarbons have been separated

from the acid catalyst. The isobutane refrigerant is then utilized to exert its full beneficial effect throughout the entire reaction zone and, in addition, relieves the deisobutanizer tower of an equivalent overhead load.

As the need for alkylation feed stocks increases, as need for higher alkylate quality arises, or as deisobutanizers become the bottlenecks of existing plants this two stage process should be investigated. All the operating conditions of absorber temperature, absorber residence time, acid: olefin ratios, etc. as required for high quality and yields have been well established by pilot plant operation and the process could be applied commercially with very little further investigative work.

Summary. The capacity of existing HF alkylation contactors can be considerably increased by the installation of new type cooling elements with no increase in power requirements. New HF alkylation contactors are rated up to the capacity of these new cooling elements and are installed in horizontal position without steel supporting structure and with simplified drives, thus effecting large savings in investment cost and utilities for a given capacity.

The capacity of existing sulfuric acid alkylation contactors and existing refrigeration systems can be increased in many cases by the installation of refrigerant pumps and new type cooling elements. New sulfuric acid alkylation reactor systems, employing horizontal contactors with the new type cooling elements are built with simplified drives and without steel supporting structure to effect economics of both material and investment cost. In some cases either new or existing units can utilize the principle of "effluent refrigeration" to greatly increase isobutane olefin ratios. Effluent refrigeration involves the use of the total hydrocarbon from the settler as the refrigerant to the cooling elements of the contactor reactor and the evaporation of isobutane from this hydrocarbon effluent to effect the cooling in the reactor. The evaporated isobutane is condensed and recycled entirely through the reaction zone and settler before again being evaporated within the cooling elements of the contactor.

The two stage alkylation process wherein olefins are first absorbed in recycle acid prior to their introduction into the reaction zone offers possibilities for increasing the supply of available olefinic alkylation feed stocks and for improving the quality of alkylate made from existing feed stocks, which contain large quantities of normal paraffins. * * *

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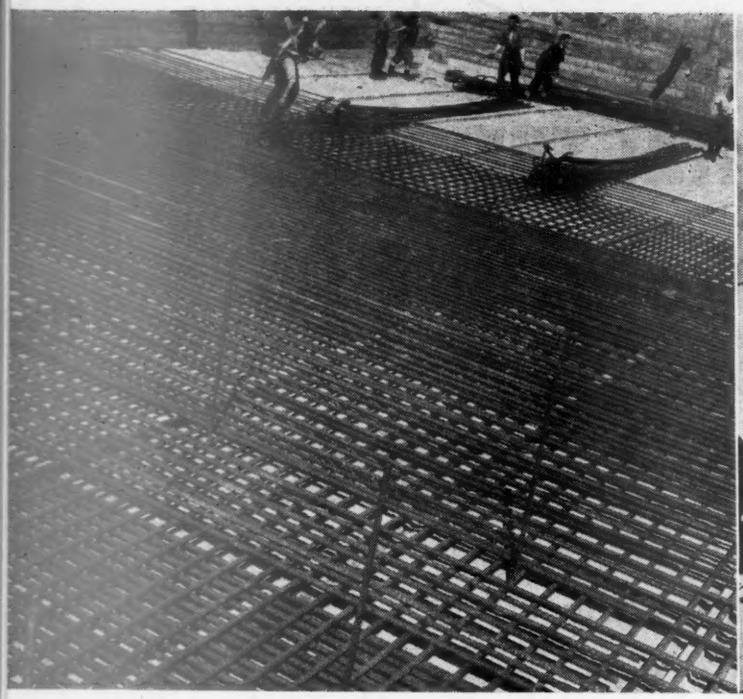
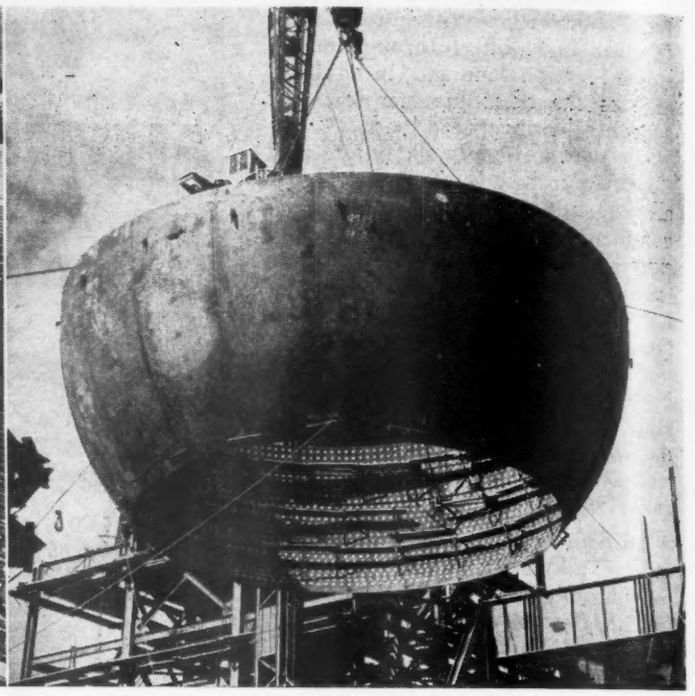


Reinforcing rods, cat cracker foundations.

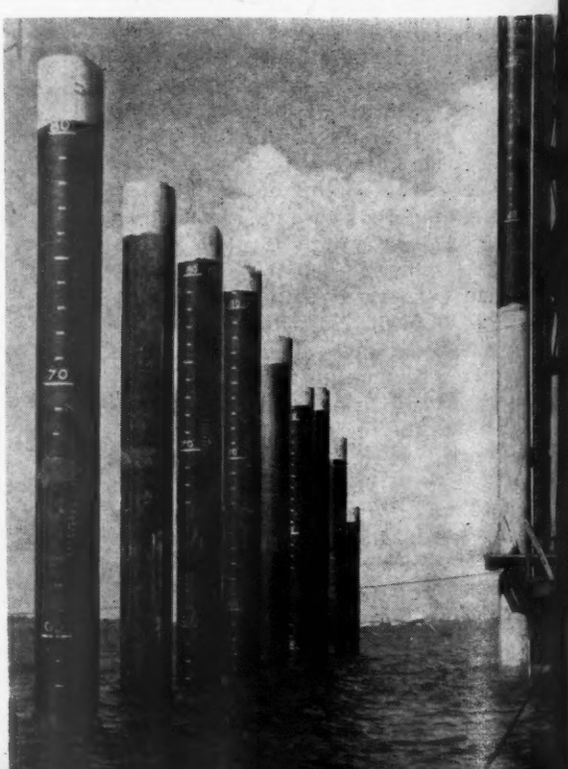


Lifting the regenerator cone into position.

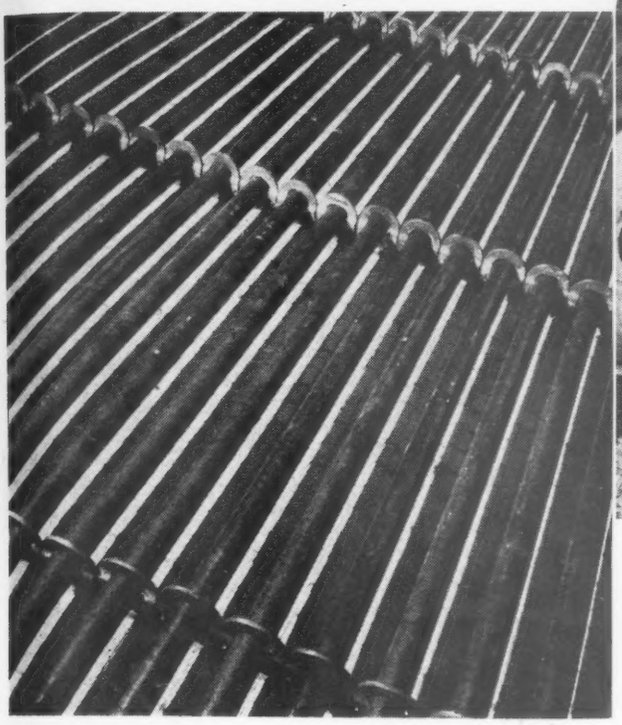
Fawley Refinery to Open in August

PICTURE STORY

This photo story of the construction work at the Fawley, England, plant of Anglo-American (Jersey Standard) shows progress being made. At left, pile driving foundations, and below marine terminal where piles in Southampton water are 85 ft. (See The Petroleum Engineer, April, 1950 for detailed article.)

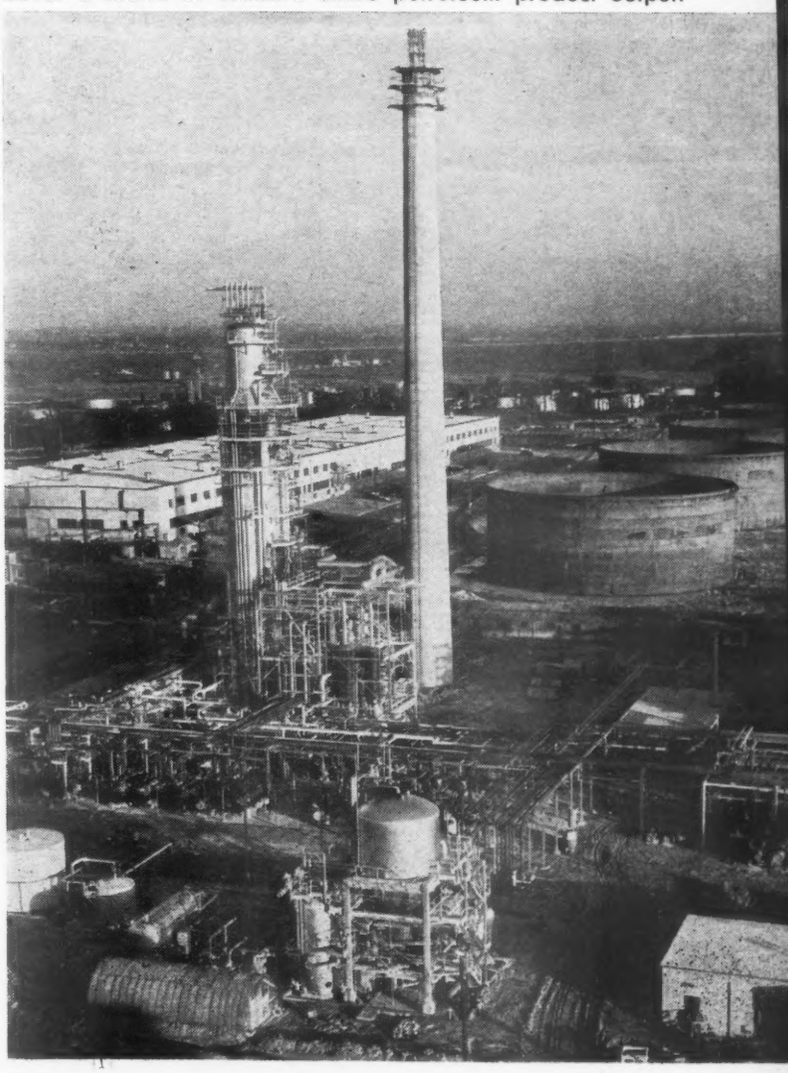


Overhead piping inside heater of single stage crude unit. The Fawley refinery in England will cost more than $100,000,000 to build and will require some 2000 employees for operation.

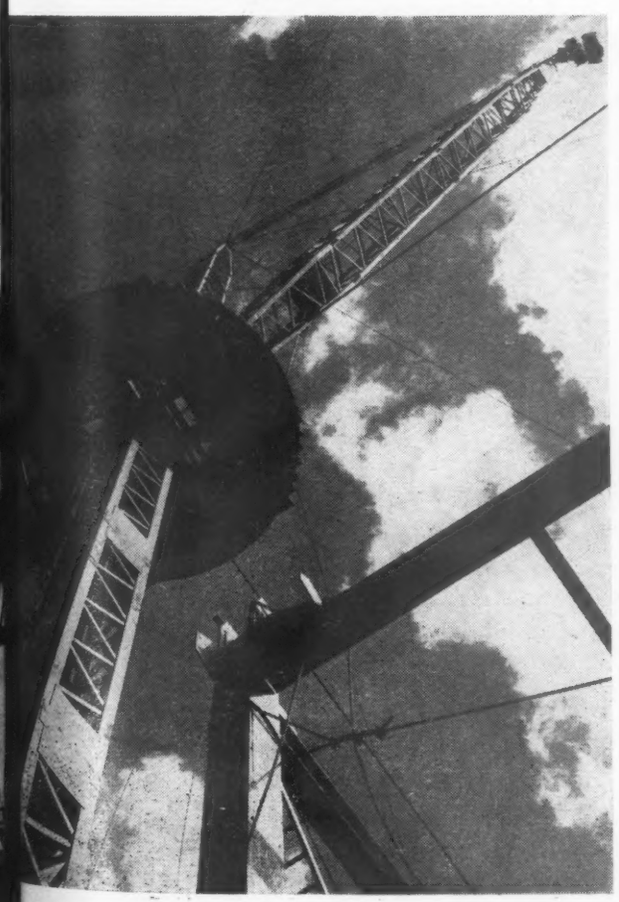


Spraying oil pipe lines with silver paint.

Single stage crude unit from top of lift shaft. The completed refinery will handle 110,000 bbl of crude oil a day or about a fourth of Britain's entire petroleum product output.



The 295-ft guy derrick erected for the catalytic cracker lifts.



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The Technical Forum

Pressure Drop In Exchangers

Q Please describe in detail with equations the most effective procedure for determining shell and tube condenser and evaporator pressure drops for condensation and vaporization in tubes of both horizontal and vertical exchangers on both shell and tube sides.

In the formula $P = \frac{L\,v^2}{k\,s}$

Where: P = pressure drop, psi.
L = length of vapor travel
v = average velocity, ft per sec
s = specific volume, cu ft per lb
k = 9,000 to 13,000

What determines the value of k and how may it be calculated for different services? If it is a function of viscosity then what are the limits corresponding to 9000 and 13,000?

J. D. H.

A Chilton and Genereaux, Trans. Am. Inst. Chem. Engrs., *29*, 161, (1933) present the following equation for pressure drop in turbulent flow across tube banks:

$$\Delta p = \frac{4\,f\,N_r\,\rho\,(V\,max)^2}{2g_c} \quad . \quad (1)$$

Δp = pressure drop, lb/ft²
N_r = number of rows of tubes normal to flow
ρ = density of fluid lb/ft³
V max. = fluid velocity through minimum area available for flow.
μ = viscosity of fluid, lb/ft-sec.
gc = gravitational conversion factor, 32.17 ft/(sec)²

$$f = 0.75\left(\frac{D_c\,V\,max.\,\rho}{\mu}\right)^{-0.2}$$

D_c = transverse clearance between tubes, ft. (see Fig. 1.)

Density of fluid, $\rho = \frac{1}{s}$, where s is defined above. N_r is proportional to length of travel, L, and average velocity, v, is proportional to V max. Thus Equation (1) may be written in the form.

$$p = \frac{f}{k}\,\frac{L_v^2}{s}$$

k is a constant that depends on the physical construction of the exchanger.

f depends on physical construction of the exchanger, velocity, and viscosity.

With the foregoing in mind it is recommended that Equation (1) be used to compute pressure drop of a fluid across tube banks in a shell-and-tube exchanger, if the fluid is in turbulent flow. Turbulent flow occurs at $\frac{D_c\,V\,max\,\rho}{\mu}$ greater than 40. Application of Equation (1) is best understood by example.

Example 1. Water enters the shell side of a shell-and-tube exchanger at the rate of 309 lb/sec. Entering temperature is 105 F, and exit temperature is 115 F. Compute the pressure drop on the shell side, given the data below.

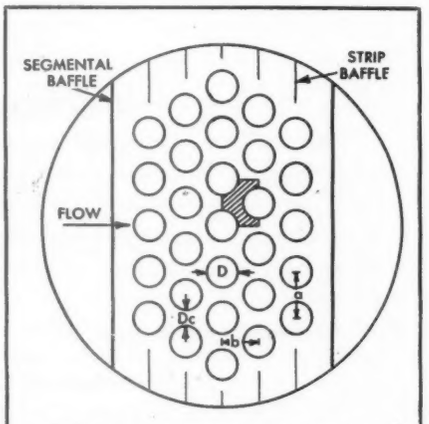

FIG. 1. Exchanger flow relationships.

Data: Tube length = 16 ft
Distance between baffles = 1 ft
Cross section layout as in Fig. 1
D = 2.00 in. = 1/6 ft
Tube pitch = 1.5D = ¼ ft
Distance between strip baffle and tube = 1.00 in. = 1/12 ft
I.D. of shell = 2 ft

$D_c = 1.5D - D = 0.5D = 1/12$ ft

Minimum area of flow = (least distance of clearance) × (baffle spacing)

Examination of Fig. 1 shows that least distance of clearance occurs at either the first or last tube row.

Least Clear. Dist. = $6D_c$ = ½ ft.

(In second and fourth rows, clearance = $7D_c$).

(In the middle row, clearance distance = $8D_c$).

Minimum area of flow = ½ × 1 = 0.5 ft².

ρ water = 61.8 lb/ft³ at avg. temp. of 110 F

$$\text{Vol. flow rate} = \frac{309}{61.8} = 5\ ft^3/sec$$

$$V\,max. = \frac{\text{Vol. flow rate}}{\text{Min. area of flow}} = \frac{5}{0.5} = 10\ ft/sec$$

μ = 0.6 centipoises at 110 F = 0.0004032 lb/ft-sec

$$f = 0.75\left(\frac{1/12 \times 10 \times 61.8}{0.0004032}\right)^{-0.2}$$

$f = 0.0715$

N_r = 5 in Fig. 1

$$\Delta p = \frac{4 \times 0.0715 \times 5 \times 61.8 \times (10)^2}{64.34}$$

$\Delta p = 137.2$ lb/ft²

There are

$$\frac{16\ (\text{ft tube length})}{1\ (\text{ft baffle spacing})} = 16$$

shell passes in the exchanger

$$\Delta p' = \frac{137.2}{144} \times 16 = 15.25 \text{ psi}$$

In the viscous-flow region, Chilton and Genereaux suggest:

$$\Delta p = \frac{53\ L\ V_{max}}{g_c\ D_e^2} \quad . \quad . \quad (3)$$

L = length of tube bank in direction of flow, ft

D_e = equivalent diameter, ft

$$D_e = \frac{4\ [ab - (\pi/4)\ D^2]}{\pi\ D}$$

. . . . . (4)

(See Fig. 1 for definition of a and b.

$$D_e = \left(\frac{4 \times (\text{shaded area})}{\text{wetted perimeter}}\right)$$

Pressure drop on the shell side of exchangers when either boiling or condensing is occurring on the shell side is usually negligible, since very low rates of flow are involved. If high rates of flow are encountered the subsequent remarks concerning phase changes inside tubes apply.

Due to the wide variety of conditions encountered and the change of heat transfer coefficient, there is no general correlation applicable for estimation of pressure drop during phase change inside tubes. An idea of the magnitude of the pressure drop can be obtained by computing pressure drop on the basis of 100 per cent liquid flow throughout the phase change region, computing the pressure drop on the basis of 100 per cent vapor flow, and averaging the two. This following equation may be used in each case:

$$\Delta p = \frac{2\ fL\ V_{av.}^2}{g_c\ D\ s} \quad . \quad . \quad (5)$$

s = specific volume of fluid, ft^3/lb

$V_{av.}$ = avg. vel. of fluid, ft/sec

Δp = pressure drop, lb/ft^2

It may be noted in passing that Equation (5) is of the same general form as the equation in the original question. Again the "k" term would involve f and D.

A procedure (detailed and tedious) which will give a fairly accurate value for pressure drop during phase changes inside tubes is outlined below:

1. Determine overall U's at various tube lengths throughout phase change region.

2. Obtain instantaneous values of heat transfer at various points throughout phase change region. (Graphically, based on U's in 1.)

3. Plot amount of liquid (or vapor) formed throughout phase change region.

4. Calculate Δp of liquid and Δp of vapor separately and add to get total Δp.

Even in this method, data for calculating the interaction between phases due to a common boundary layer are lacking. The correct friction factors for use would probably be a complex function of the physical properties of the fluids and the turbulence of the streams. The safest procedure in this case would be to rely on experimental data.

G. L. Farrar
A. M. Platt

Aviation Fuel in Automotive Engines

Q I would appreciate some information concerning the use of 115/145 octane aviation gasoline in automobiles, especially 1950 models. Whether it is harmful, and why, if it is, etc. I have heard this subject discussed pro and con many times. Some claim that it burns the valves, some claim that it has no more effect on a motor than straight run gasoline.

Does 115/145 produce a better explosion than 100?

T. M.

A There is little doubt that most of us could burn 115/145 aviation gasoline in our 1950 automobiles without knowing whether it was ordinary gasoline or something else. Due to the lower end point and higher API gravity it may be expected to deliver fewer miles per gallon than regular gasoline, unless it were burned in an engine specially designed to handle it.

To answer the question, "Does 115/145 produce a better explosion than 100?", is somewhat like trying to say whether wool or denim makes the better suit. Unless the conditions are explicitly stated, it is impossible to answer "yes" or "no," because under some conditions and by certain criteria the answer might be "yes" and under other conditions and by other criteria the answer would be "no."

In the main, the answer can be "yes" when the automotive engine has a compression ratio high enough to take advantage of the higher octane number of the aviation fuel, that is, 115 for ordinary lean mixture air-fuel ratio, on which the automotive engine operates habitually, except when choked for starting purposes or for some such reason the mixture is enriched temporarily. With a compression ratio of, say, 8 to 1 or higher, the automotive engine can take advantage of the higher anti-knock properties of the aviation fuel and deliver more power than ordinary housebrand or even premium—Ethyl for example—motor fuel. In automotive engines of any standard model or year, built for 80-95 Research octane number fuels, the aviation fuel will show very little, probably no advantage over motor fuels. Also, with lower weight per gallon, the mileage of the aviation fuel will be slightly lower, probably.

As to burning valves, there is a possible tendency to burn valves more readily under certain operating conditions, if the aviation fuel contains more tetraethyl lead per gallon, as it frequently does. This is not a certainty, since the mere presence of more lead does not guarantee more probable valve-'burning' at all. Under certain conditions more lead content *may* induce valve damage, but this tendency is traceable in many cases to causes other than lead content, or to the 'collaboration' of other conditions with the presence of larger quantities of lead, not to lead alone. To answer these questions unequivocally all the conditions of operation including engine specifications, etc., must be given clearly.

C. R. Wagner

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Determination of Hydrocarbon Liquid-Vapor Equilibria

Calculations under Raoult and Henry laws of dew points, bubble points, liquid-vapor compositions.

G. L. FARRAR†

A LARGE number of processing steps in the natural gasoline and petroleum refining industries are purely "physical" in nature, i.e., no chemical change takes place. Calculations involving these physical processes may be resolved into three categories, (1) mass balance, (2) heat or energy balance, and (3) equilibrium considerations. The normal procedure in making these calculations is to determine first the mass balance. Then the heat or energy balance is completed. The basic premise in both these determinations is that mass and energy are neither created nor destroyed in a physical process, and that the net gain or loss of mass or heat in a system is zero. Once the heat and mass balances are determined, equilibrium calculations are made. This paper will be concerned with determination of vapor-liquid equilibrium in hydrocarbon systems. Furthermore, the systems will be limited to those which can be completely analyzed in terms of each individual hydrocarbon present.

Equilibrium may be defined as that condition when all the various driving forces in a given system have become equalized and there is no further change in the system. Consideration of equilibrium in the connection used here will be restricted to stable equilibrium, or that type that may be attained in a matter of hours at the most. Sometimes it is not economically feasible in commercial application to allow a process to reach equilibrium, due to time considerations. However, equilibrium usually may be approached closely in comparatively short time in liquid-vapor systems.

Equilibrium relationships in some systems may be predicted from general laws, as shown below. In others experimental correlations must be referred to. In either case the results are applied in the design and operation of flash separators, distillation columns, and absorption columns. Examples or indications of these uses are given after the development of the equilibrium equations.

Basic Theory.

In consideration of vapor-liquid, or phase equilibrium, it is first necessary to obtain an understanding of the number of variables that must be set in order to define a system. This information may be obtained from the Gibbs Phase Rule,

$F = C - P + 2$

F = degrees of freedom
C = number of components
P = number of phases

The degrees of freedom correspond to the number of variables that must be set. If the number of phases is restricted to two, corresponding to a homogeneous liquid phase in equilibrium with a gas phase,

$F = C - 2 + 2 = C.$

Thus the variables that must be fixed are equal to the number of components present. If there is one component, either the temperature or pressure may be set, and the pressure or temperature is then defined *at equilibrium*. The plot of vapor pressure versus temperature for the given component shows the pressure defined at each temperature for the liquid and vapor to be in equilibrium.

If there are two components in a system there are two degrees of freedom. Then two of the three possible variables must be fixed to define a two-phase system at equilibrium. These variables are temperature, pressure, and concentration of one of the components. It may be seen, then, that as the number of components increases, additional concentrations of components must be specified. These concentrations may be given in either the liquid or gas phase. In most cases the composition of the mixture is known, and it is desired to determine the temperature to define equilibrium at a given pressure. It may be seen that in this case, concentration of all components except one must be specified. This automatically sets the concentration of the other component, since the summation of the concentrations (given as mol fractions) must equal 1.

From the foregoing it may be concluded that the degrees of freedom must at least be equal to the number of components. It should be pointed out also that it is not possible to set arbitrarily the level of the other variable, since the system is completely defined without additional restraint.

The relationship between the concentration of a given component in the liquid and the concentration of that component in the gas at equilibrium is given by Henry's Law,

$y_A = KX_A$

y_A = mol fraction of component A in the gas phase
X_A = mol fraction of component A in the liquid phase
K = phase equilibrium constant

In the general case, K must be determined experimentally or calculated from fugacity relationships, as explained later.

If the pseudo-reduced temperature, T_R ($T_R = T/T_C$) is greater than about 0.80 and the reduced pressure, P_R ($P_R = P/P_C$) is less than about 0.10, a special case of Henry's Law, known as Raoult's Law, may be applied.

Raoult's Law states that in an equilibrium mixture the partial pressure of a component in the liquid is equal to the partial pressure of that component in the vapor,

$P_A X_A$ = partial pressure of component A in the liquid =
πy_A = partial pressure of component A in the gas.

or,

$P_A X_A = \pi y_A$

P_A = vapor pressure of component A in the pure state at system temperature
π = total pressure on the system
X_A, y_A = mol fractions, as defined before.

Systems Obeying Raoult's Law

When Raoult's Law is applicable, equilibrium calculations are made more easily than when Henry's Law must be used and for this reason this subject will be developed more thoroughly. For a two component mixture,

$$X_A P_A = \pi y_A \text{ and } X_B P_B = \pi y_B$$

$$X_A + X_B = 1;\ X_B = 1 - X_A$$

$$\frac{P_A X_A}{\pi} = y_A;$$

$$\frac{P_B X_B}{\pi} = \frac{P_B(1 - X_A)}{\pi} = y_B \quad . \quad (1)$$

†Assistant Professor of Chemical Engineering, Texas A. & M. College, College Station, Texas.

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$$y_B + y_A = 1 = \frac{P_A X_A}{\pi} + \frac{P_B(1 - X_A)}{\pi}$$

$$\frac{P_A X_A}{\pi} + \frac{P_B}{\pi} - \frac{P_B X_A}{\pi} = 1$$

$$X_A (P_A - P_B) = \pi - P_B \quad . \quad (2)$$

$$X_A = \frac{\pi - P_B}{P_A - P_B} . \quad . \quad (3)$$

Equation 3 may be used to compute X_A knowing only π and the temperature, which sets P_A and P_B. Then y_A is calculated from Raoult's Law. X_B and y_B may be obtained from Equations 1 and 2.

Equation 3 is used most often to obtain a boiling point diagram, as shown in Fig. 1. To calculate a boiling point diagram, the pressure is first set at the desired value. The lower temperature limit of the boiling point diagram is set by observing the temperature at which the vapor pressure of the low-boiling material is equal to the total system pressure. Likewise, the upper temperature limit is set by observing the temperature at which the vapor pressure of the high-boiling component is equal to the total system pressure. Then various temperatures are selected between the two temperature limits, and composition of liquid and vapor in equilibrium at each temperature are calculated. Curves of liquid and vapor compositions are plotted to complete the boiling point diagram. Note that there is a double scale on the abscissa, one scale referring to one component and the other scale referring to the second component. At 85 F, the mol fractions of n-butane in the vapor and liquid are 0.865 and 0.633, respectively. Mol fractions of n-pentane in the vapor and liquid are 0.135 and 0.367 respectively. Calculations necessary for construction of Fig. 1 are shown below in Example 1.

Example 1:—Calculate the data necessary to construct the boiling point diagram for mixtures of n-butane and n-pentane at a pressure of 30 psia.

Solution:—

Vapor pressure of n-butane = 30 psia at 67 F.

Vapor pressure of n-pentane = 30 psia at 138 F.

Assume temperatures of 85, 100, and 120 F for calculation of intermediate points.

At 100 F, $P_{c_4} = 53$ psia

$P_{c_5} = 15$ psia

Applying Equation 3,

$$X_{c_4} = \frac{\pi - P_{c_5}}{P_{c_4} - P_{c_5}} = \frac{30 - 15}{53 - 15} = 0.395$$

$$X_{c_5} = 1.000 - 0.395 = 0.605$$

$$y_{c_4} = \frac{P_{c_4} X_{c_4}}{\pi} = \frac{(53)(0.395)}{30} = 0.698$$

$$y_{c_5} = 1.000 - 0.698 = 0.302$$

Tabulations of calculations made in the same manner for other temperatures are shown below.

Temperature, F	P_{c_4}, psia	P_{c_5}, psia	X_{c_4}	y_{c_4}	X_{c_5}	y_{c_5}
67	30	..	1.000	1.000	.....	.....
85	41	11	0.633	0.865	0.367	0.135
100	53	15	0.395	0.698	0.605	0.302
120	71	22	0.163	0.386	0.837	0.614
138	..	30	.....	.....	1.000	1.000

For substances obeying Raoult's Law, data may be taken from this boiling point curve and plotted as shown in Fig. 2. This is the McCabe-Thiele diagram, used for distillation of two-component mixtures. Note that the ordinate is mol fraction of the more volatile component (n-butane in Example 1) in the vapor, while the abscissa is mol fraction of the more volatile component in the liquid. Values for the equilibrium curve are found from Fig. 1 by selecting each pair of values from n-butane at a constant temperature. Calculations of the operating lines, and subsequently the number of plates are beyond the scope of this paper. The reader is referred to any of the several standard chemical engineering books on unit operations for details of these calculations.

The method for binary mixtures obeying Raoult's Law may be extended to multi-component mixtures. By knowing the composition of *either* the liquid or vapor in an equilibrium mixture and temperature, it is possible to calculate the pressure directly. If the vapor composition is known, this is done by obtaining $\frac{y}{P}$ for each component and adding all the values for $\frac{y}{P}$ together. It is obvious that all the mol fractions in the liquid must add up to unity. Thus Equation 4 follows from Raoult's Law,

$$\Sigma X = 1.000 = \pi \Sigma \frac{y}{P}$$

and,

$$\pi = \frac{1.000}{\Sigma \frac{y}{p}} \quad . \quad . \quad (4)$$

This point can be made clearer by Example 2 as follows:

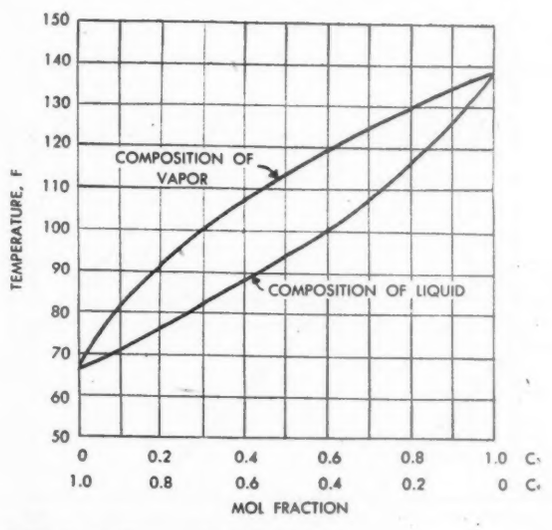


FIG. 1. Boiling point diagram.

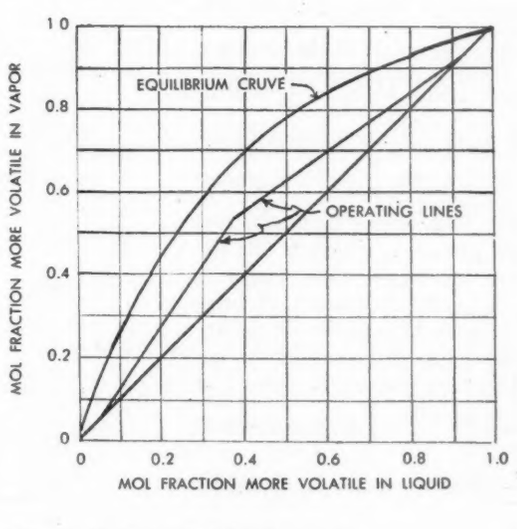


FIG. 2. McCabe-Thiele diagram.

Example 2:—Vapor leaves a partial condenser operating at an exit temperature of 70 F at the following rate: 50 lb/hr of propane, 75 lb/hr of isobutane, 125 lb/hr of n-butane, and 100 lb/hr of n-pentane. Calculate the pressure in the condenser.

Solution:—

Component	(1) lb	(2) MW	(3) mols	(4) Vapor pressure, psia
propane	50	44	1.136	125.0
isobutane	75	58	1.293	46.0
n-butane	125	58	2.155	31.5
n-pentane	100	72	1.389	7.7
			5.973	

The mol fraction of each component in the vapor is computed by dividing the mols of each component by 5.973.

Component	(5) y	(6) y/P	(7) $X=\pi y/P$
propane	0.190	0.00152	0.0318
isobutane	0.216	0.00471	0.0983
n-butane	0.361	0.01145	0.2392
n-pentane	0.233	0.03019	0.6307
	$\Sigma y=1.000$	$\Sigma\frac{y}{P}=0.04787$	$\Sigma X=1.0000$

$$\pi=\frac{1.000}{\Sigma y/P}=\frac{1.000}{0.04787}=20.9 \text{ psia}$$

After y is obtained for each component, y/P is obtained by dividing the mol fraction of each component in the vapor by vapor pressure. π is then calculated as indicated above, and values for X are computed by the relationship, $X=\frac{y}{P}\cdot\pi$, and recorded in column (7).

If pressure and composition of the vapor are known, the temperature must be assumed. If assumed temperature is correct, the calculated $\Sigma X=\pi\Sigma\frac{y}{P}$, obtained as shown in Example 2, will be equal to unity. If the assumed temperature is too high, $\pi\Sigma\frac{y}{P}$ will be less than unity; if the assumed temperature is low, $\pi\Sigma\frac{y}{P}$ will be greater than unity. This arises from the fact that vapor pressure, which is the denominator, increases with temperature. By the same reasoning, if pressure and composition of the liquid are known, the temperature must be assumed. The temperature is correct at $\Sigma y=\frac{1}{\pi}\Sigma PX=1$; temperature is high if $\frac{1}{\pi}\Sigma PX$ is greater than unity; temperature is low if $\frac{1}{\pi}\Sigma PX$ is less than unity.

Systems Where Henry's Law Applies

As indicated earlier, Henry's Law must be applied when Raoult's Law does not hold. The evaluation of K in Henry's Law may be rather time-consuming, if not difficult. Actually K is a function of temperature, pressure, and composition of the system when more than two components are present. However, as long as the difference in boiling points of the components present is not great, it is possible to correlate K for hydrocarbons with only temperature and pressure, without appreciable error. If there are considerable amounts of methane and/or ethane in a mixture, K values must be obtained from systems of similar concentrations. Otherwise the equilibrium constants as presented by a number of investigators give satisfactory results.

It should be pointed out that K may be calculated from fugacities of the liquid and vapor, but that these calculated values are not as accurate as those obtained experimentally. At the present state of the knowledge, K is best obtained simply by bringing a given system to equilibrium, analyzing the liquid and vapor, and back-calculating. Knowing X_A and y_A, K_A is readily obtained. Most K charts have been prepared in this manner.

A typical plot of equilibrium constant, K, for a given component is shown in Fig. 3. As shown there, the logarithm of pressure is plotted, rather than the pressure itself. This gives a more nearly linear relationship for K as pressure is varied. The reason for this becomes apparent when it is remembered that K is a correlated value for $\frac{P}{\pi}$, and that logarithm of vapor pressure as a function of temperature results in a straight line plot. K is shown on the abscissa, and temperature is the parameter.

The sharp bend in the curve at low temperatures shows that the possibility exists for retrograde vaporization or condensation in this region. This phenomenon may occur if the mixture under consideration is made up of components that have the same type of bend in the K curve at the given temperature.

The boiling point for a two-component mixture may be worked out using Henry's Law in a manner very similar to that employing Raoult's Law.

$$y_A=K_A X_A;\ y_B=K_B X_B \quad (5)$$

$$X_B=1-X_A;\ y_B+y_A=1$$

$$K_A X_A+K_B(1-X_A)=$$

$$y_B+y_A=1$$

$$K_A X_A-K_B X_A+K_B=1$$

$$X_A(K_A-K_B)=1-K_B \quad (6)$$

$$X_A=\frac{1-K_B}{K_A-K_B} \quad (7)$$

For a given pressure, the lower temperature limit is set at the point where K of the low-boiling component is equal to 1. The upper temperature limit is set up at the point where K for the high-boiling component is equal to 1. Then using Equations 5, 6, and 7 at various temperatures in the range, the boiling point curve may be constructed in a manner similar to Example 1.

The boiling point of a multi-component mixture is not defined. Instead

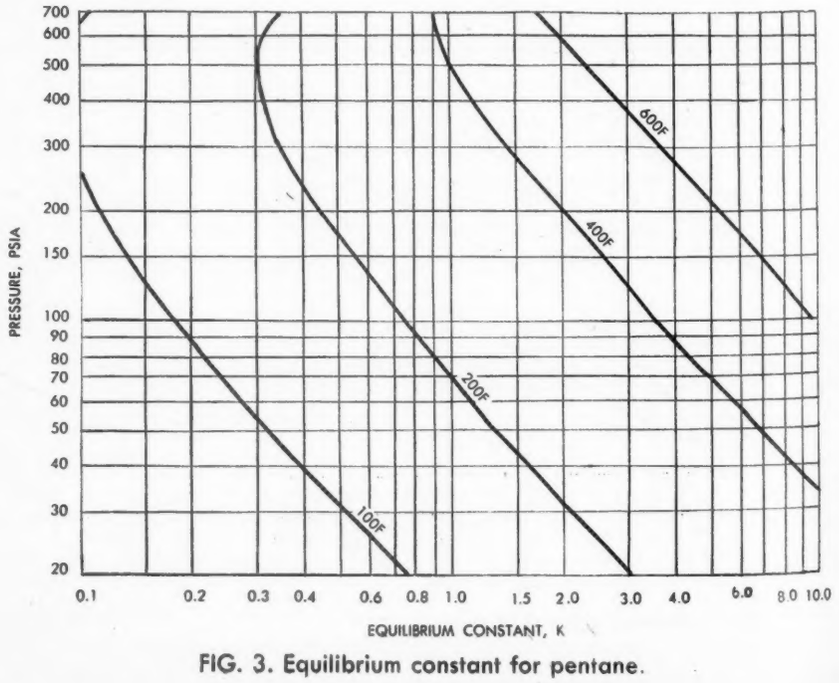


FIG. 3. Equilibrium constant for pentane.

there is a boiling range, bounded by the point at which the first bubble of vapor is vaporized from liquid, and the point at which the first drop of liquid is condensed from the vapor. The former point is defined as the bubble point, while the latter is defined as the dew point. A liquid may be raised to its bubble point and completely vaporized at constant temperature by reducing the pressure, or the same phase change may be accomplished at constant pressure by raising the temperature. A vapor may be condensed by increasing the pressure at constant temperature or by decreasing the temperature at constant pressure.

It is necessary to determine the bubble points and dew points of various mixtures in fractionation and flash separators. In this connection it should be noted that when liquid and vapor are in equilibrium the liquid is at its bubble point and the vapor is at its dew point. The determination of bubble points and dew points is a trial-and-error procedure. If temperature is known, pressures must be assumed until the equilibrium conditions are satisfied. Likewise, if pressure is known, temperatures must be assumed until the equilibrium conditions are satisfied.

When determining a bubble point the liquid composition and either temperature or pressure are given. Then.

$$\Sigma y = \Sigma Kx = 1.000 \quad . \quad . \quad . \quad (8)$$

Application of this equation is shown in Example 3 below.

Example 3:—A liquid mixture of hydrocarbons has the following analysis in mol per cent:

	Per cent
propane	25.0
isobutane	25.0
n-butane	25.0
n-pentane	25.0
	100.0

At a pressure of 200 psia, calculate the temperature at the dew point.

Solution:—Assume temperature = 178 F.

Component		T=178 F π=200 psia K	y=Kx
propane	0.250	1.83	0.458
isobutane	0.250	1.00	0.250
n-butane	0.250	0.815	0.204
n-pentane	0.250	0.355	0.089
	ΣX=1.000		Σy=1.001

Therefore the bubble point of this mixture at 200 psia is 178 F, and the assumption is correct.

When determining the dew point of a mixture the composition of the vapor and either the temperature or pressure should be given. If pressure is given the temperature must be assumed. Then

$$\Sigma X = \Sigma {}^{y}/_{k} = 1 \quad . \quad . \quad . \quad . \quad (9)$$

Application of this procedure is shown in Example 4.

Example 4:—A gaseous mixture of hydrocarbons has the following analysis (mol per cent):

	Per cent
propane	45.8
isobutane	25.0
n-butane	20.4
n-pentane	8.8
	100.0

At a pressure of 200 psia, what is the dew point temperature of this mixture?

Solution:—Assume temperature = 178 F

Component	y	t=178 F π=200 psia k	X=y/k
propane	0.458	1.83	0.250
isobutane	0.250	1.00	0.250
n-butane	0.204	0.815	0.250
n-pentane	0.088	0.355	0.248
	Σy=1.000		ΣX=0.998

Thus X is substantially equal to unity and the temperature at the dew point is 178 F, which checks the assumption.

On comparison of Examples 3 and 4 it is seen that the compositions of the liquid and vapor are identical in each case, even though one calculation is a determination of bubble point, while the other is a determination of dew point. This serves to illustrate a statement previously made, that when a liquid and vapor are in equilibrium, the liquid is at its bubble point and the vapor is at its dew point.

Calculation of $\frac{V}{L}$ Ratio

It may be seen that a system may be under such conditions of temperature and pressure that a two-phase mixture exists, at some intermediate point between the bubble point and dew point. When this condition exists it is frequently important to know the total amount of the mixture in each phase. A method to permit this calculation is developed below. Let:

F = initial total mols of material
V = mols of vapor under given conditions
L = mols of liquid under given conditions
x = mol fraction of given component in the liquid
y = mol fraction of given component in the vapor
W = initial mol fraction of given component in total mixture

By a material balance,

$$F = V + L$$

By a component material balance

$$FW = Vy + Lx$$

But

$$y = Kx$$

Then

$$FW = KVx + Lx$$

$$FW = Lx\left(K\frac{V}{L} + 1\right)$$

$$Lx = \frac{FW}{\left(\frac{KV}{L} + 1\right)} \quad . \quad . \quad . \quad . \quad (10)$$

and

$$x = {}^{y}/_{K}$$

$$FW = Vy + L{}^{y}/_{K}$$

$$F = Vy\left(1 + \frac{L}{KV}\right)$$

$$Vy = \frac{FW}{\left(1 + \frac{L}{KV}\right)} \quad . \quad . \quad . \quad . \quad (11)$$

Equations 10 and 11 define the relationship between the amount of each component in the liquid and vapor under final conditions, in terms of the amount of that component in the total mixture. Also since $\Sigma X = 1$ and $\Sigma y = 1$,

$$\Sigma Lx = L\Sigma x = L \quad . \quad . \quad . \quad . \quad (12)$$

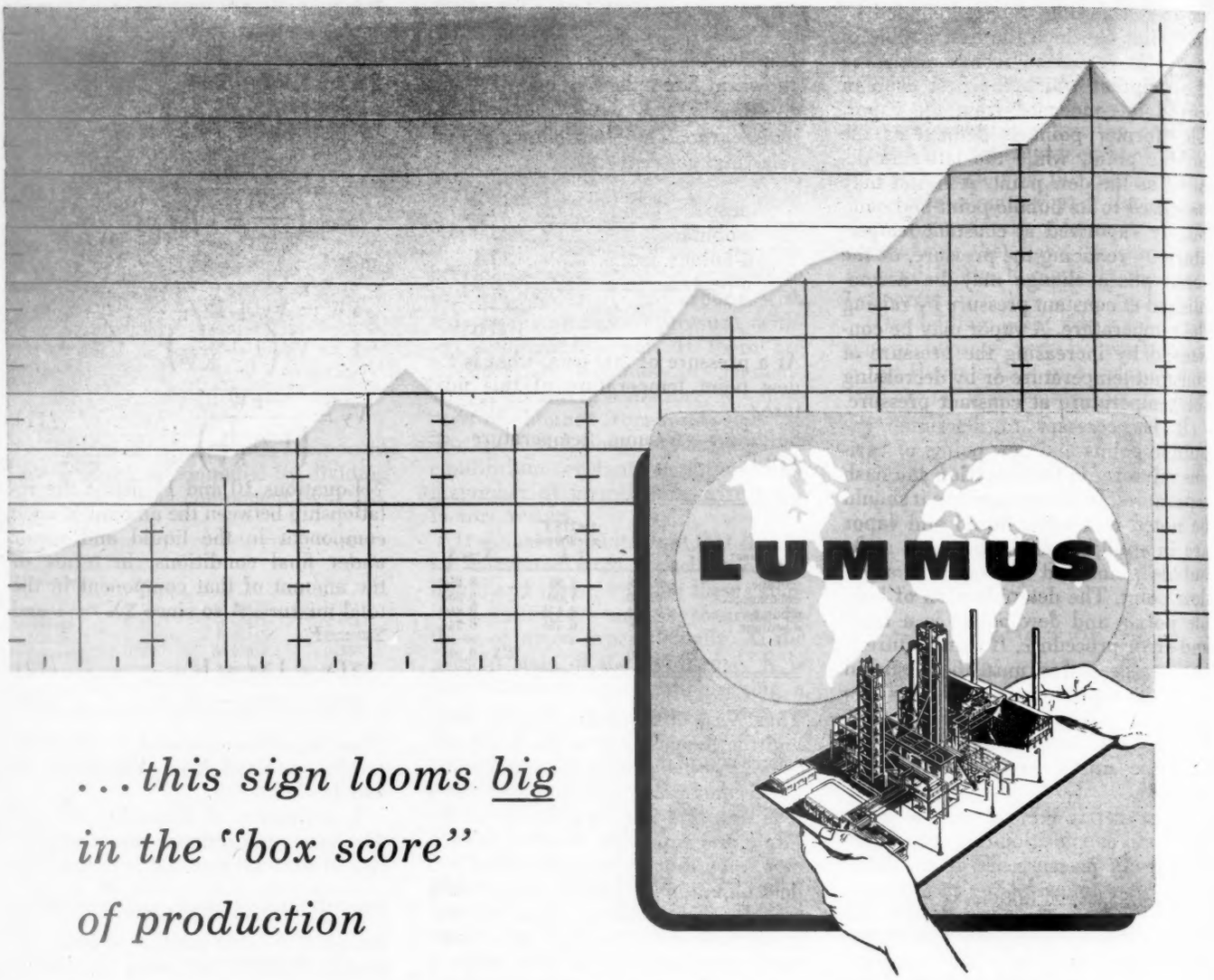
$$\Sigma Vy = V\Sigma y = V \quad . \quad . \quad . \quad . \quad (13)$$

These equations are used to check the results obtained from Equations 10 and 11.

Examination of Equations 10 and 11 shows that amount and composition of the total material in the system, temperature, pressure, and $\frac{V}{L}$ must be known if a direct solution is to be obtained. Usually, all other conditions are known and $\frac{V}{L}$ is to be calculated. Again a trial-and-error procedure is used. $\frac{V}{L}$ is assumed, and Lx and Vy are calculated for each component. Then Equations 10 and 11 are used to check the assumed $\frac{V}{L}$. When these equations are satisfied the assumed $\frac{V}{L}$ is correct. A demonstration of this procedure is given in Example 6.

Example 6:—A gaseous mixture has the following analysis, 30 mol per cent propane, 40 per cent isobutane, and 30 per cent n-butane. This mixture is cooled to 200 F at 300 psia. Calculations show the dew point at 200 F occurs at a pressure of 284 psia, while the bubble point occurs at 321 psia. Thus the mixture is in the two-phase region and it is desired to calculate the relative amount of liquid and vapor present and the composition of each phase.

Solution:—Assume 100 mols of original gaseous mixture. Assume $\frac{V}{L} = 1$



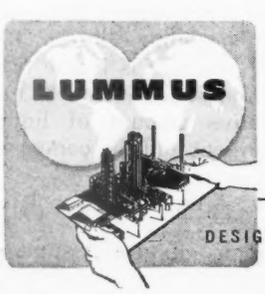
. . . this sign looms big in the "box score" of production

For better than sixty years the Lummus sign has meant *excellence* in the designing, engineering and constructing of petroleum refineries and chemical plants. It means the same today. And you need take only a short mental jump to see its importance in the days ahead, as oil refiners and chemical producers are called upon to break and re-break production records.

Let's look at a partial "box score" of Lummus' current contributions toward these world-wide objectives. In the U. S. and abroad, Lummus is engaged in seven catalytic cracking projects—as well as in providing alkylation facilities—to meet the record-breaking demand for superior aviation and motor fuels.

Lummus currently has seven ethylene units "on the go" in Europe and the U. S.—plants which will operate with telling effect in supplying a vital basic raw material. One project—the Gulf Oil Corporation unit at Port Arthur, Texas—is the world's largest ethylene unit. It will produce nearly 2½ billion cubic feet yearly, increasing total U. S. production of ethylene by about 12%.

Isn't this a reassuring record for you to tie to? It strongly suggests that you think of Lummus first in your plans for petroleum refinery or chemical plant expansion.



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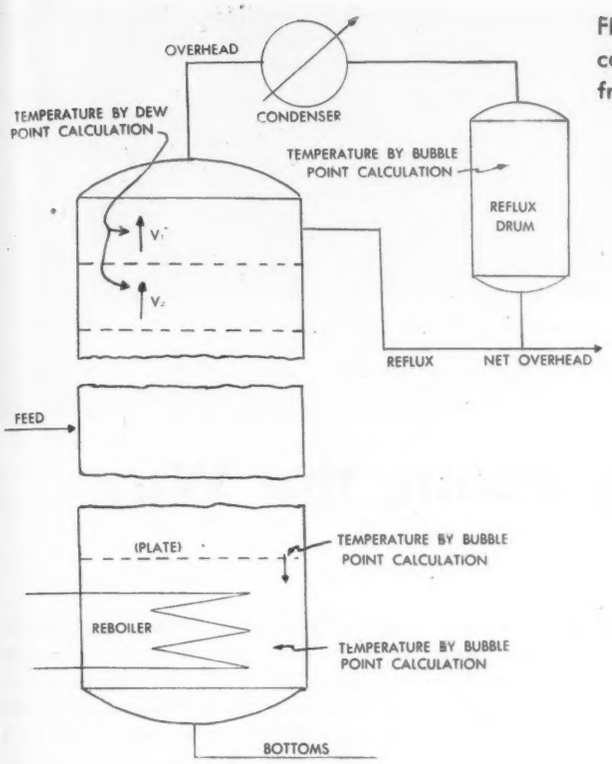


FIG. 4. Equilibrium calculations in fractionating columns.

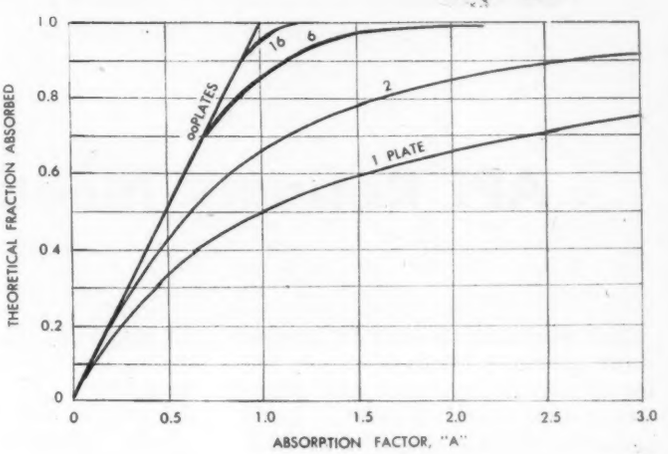


FIG. 5. Absorption factor chart.

Component	FW	p=300 psia t=200 F K	$K\frac{V}{L}$	$K\frac{V}{L}+1$	Lx	Vy*
propane	30.0	1.52	1.52	2.52	11.9	18.1
isobutane	40.0	0.90	0.90	1.90	21.1	18.9
n-butane	30.0	0.76	0.76	1.76	17.0	13.0
					50.0	50.0

*From Equation 11; calculations similar to that for Lx.

$$\Sigma Lx = L = 50.0$$
$$\Sigma Vy = V = 50.0$$
$$\frac{L}{V} = \frac{50.0}{50.0} = 1$$
$$L + V = 50 + 50 = 100 = F$$

Therefore the assumption of $\frac{V}{L} = 1$ is correct, and there are 50.0 mols each of liquid and vapor.

Component	Liquid analysis, Mol %	Vapor analysis, Mol %
propane	23.8	36.2
isobutane	42.2	37.8
n-butane	34.0	26.0
	100.0	100.0

Applications in Fractionation and Absorption.

It is not possible to go into any detail concerning the methods of computation for multi-component fractionation. Rather, it is the purpose of this discussion to indicate how the calculation of vapor-liquid equilibrium enters into this problem. The significance of each step is illustrated in Fig. 4.

The first step in the calculation involves making an overall material balance, determining the total amounts of charge, net overhead, and bottoms and the analyses of each stream. Then the temperature of the reflux drum must be computed by determining the bubble point of the overhead. The bubble point must be used since it is desired to condense all of the overhead, part of which is returned to the column as reflux, and part of which is removed as net product. The bubble point of the bottoms is calculated also, as this stream must be in equilibrium with the vapor leaving the reboiler.

The dew point is calculated on the top tray of the column, based on the composition of the gross overhead, in order to define the temperature on the top tray. Following this computation, a net heat balance is made around the column to determine the reboiler duty. The temperature of the liquid from the tray above the reboiler is calculated by determining the bubble point of this liquid. Composition and amount of this liquid are obtained by making a material balance around the bottom of the column.

A material balance is made around the top of the column, thus obtaining the amount and composition of the vapor from the second tray to the top tray. A dew point calculation will then give the temperature on the second tray. It is possible to calculate the entire column in this manner, by making alternate heat and material balances and equilibrium calculations up and down the column. Usually, however, a short cut method is used at this point. At any rate, the description has been carried far enough to show the use of liquid-vapor equilibrium calculation in fractionation.

The use of liquid-vapor equilibrium calculations in absorption computation can be exemplified in a somewhat simpler fashion than was the case for fractionation. As an example, it may be desired to check the operation of an absorber in the field. The fraction of the desired component to be removed by absorption is first calculated. Then knowing the number of plates in the absorber, a plot similar to that shown in Fig. 5 may be used to find the absorption factor "A". By definition,

$$A = \frac{L}{KV}$$

Knowing the temperature and pressure of operation, K may be obtained and $\frac{L}{V}$ calculated. The "A" values for each of the other components can then be obtained by dividing L/V by the K for that particular component. The fraction of each component absorbed can then be computed from the absorption factor chart. * * *

Members of API Refining Division meeting May 2 at Tulsa, Oklahoma.

API Refiners Meeting Points the Way

Recovery and treating of refinery waste products, elimination, combating or minimizing of corrosion effects were the two main subjects discussed before the API Refining Division Mid-Year meeting at Tulsa, April 30-May 3. Both phases of refinery operation are assuming increasing importance to the industry's economy, and state, national and municipal requirements regarding anti-pollution provisions increases the problems involved, the speakers indicated.

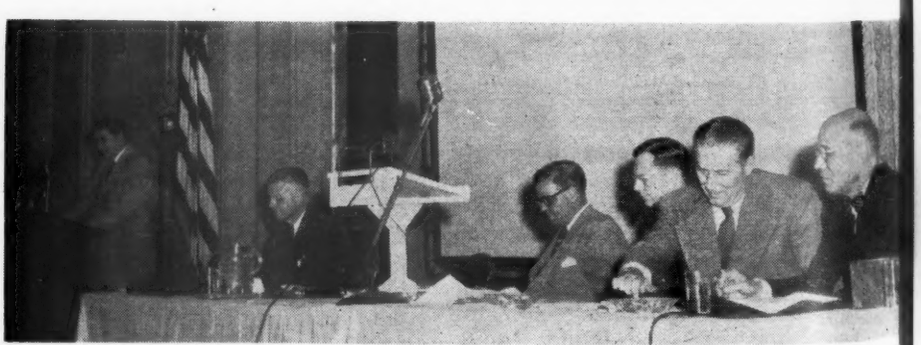
The first unit of its kind to separate and recover refinery waste products from waters has been in operation at the Petrolia, Pennsylvania, refinery of L. Sonneborn's Sons, Inc., Hans Schindler announced. Details of the plant include the source of the waste materials, obtained from the manufacture of white oils and petroleum sulfonates, as well as from the manufacture of sulfuric acid from acid sludge. All oil matter must be recovered or removed from the water before it can be discharged into a nearby stream, and the water must be essentially decolorized. Among the byproducts found in either the refined oil or the water are alkylated aromatic sulfonates, products of reaction between these hydrocarbons and the fuming sulfuric acid used to produce the white oils desired. Also acid sludge is treated to reduce it to coke and sulfur dioxide, with the latter being oxidized back to sulfuric acid, and a large volume of water containing 0.1 to 0.2 per cent of sulfuric acid acidity must be neutralized. Some emulsified oil is found in the waste water as well as water-soluble sulfonates that color the water.

Waters from these various sources are blended to obtain an average pH of 5, and the sulfonates are precipitated by lime, forming the insoluble Ca sulfonates. This treated water settles in a sedimentation basin and the neutralized ($_p$H 7.0 to 8.4) water is discharged, colorless, into the stream nearby. Sulfonates recovered are sold. The mechancial equipment of this 200,000-250,000-gal per day unit was made by Walker Process Equipment, Inc. Lime sludge is dumped into a sealed and abandoned coal mine shaft.

Another system that has shown good results is that of dissolved-air flotation of oil from waste waters. Colloid-forming chemicals are added, and aided by the dissolved-air system will yield water containing less than 25 parts per million of total oil and less than 100 ppm of total dissolved solids, says N. A. D'Arcy, Jr., consultant of Huntington Park, Calif. These units are semi-automatic in operation. Units require only one to three hours attention per 24-hour day, including lubrication and chemical mixing, the author stated.

Single-stage chambers for gravity-type oil-water separators give improved results over two-stage units, says Dr. G. A. Rolich of the University of Wisconsin. Using wax spheres of 0.92 specific gravity, to simulate the behavior of oil droplets in water, an experimental chamber was studied at five different flow rates equivalent to horizontal velocities, in the chamber, of 0.5, 1.0, 1.5, 2.0, and 2.5 ft per minute. Baffles employed following an overflow weir included a simple vertical, submerged one-sixth the water depth in the chamber; a corrugated baffle; horizontal slotted baffle, and a vertical slotted baffle. A fifth inlet was that recommended previously by the API, and the sixth was an open-channel approach to the vertical slotted baffle, which retained the most wax and gave the best hydraulic characteristics of any methods tested. The API baffle showed best at 1—the water depth submergence; the vertical baffle operated better than any other when submerged 0.8 to 0.6 the depth of the water. Tests showed that no correlation between retention and either Reynolds or Froude numbers can be made.

Corrosion problems are solved more frequently by use of more re-



A. N. Smith, Shell Oil Company is speaking. At the table are: H. G. Vesper, California Research Corporation; H. G. Osborn, Continental Oil Company, presiding; E. B. McConnell, Standard of Ohio; T. M. Rushing, The Texas Company, and H. D. Wilde, Humble Oil and Refining Company.

J. B. Macauley, Ethyl Corporation, is talking to T. L. Apjohn, Petroleum Administration for Defense, and H. Y. Hyde, Tide Water Associated Oil Company.

J. H. Dove, Anglo-Iranian Oil Company, New York City, and J. C. Geniesse, Atlantic Refining Company, stop to chat at API refining meeting.

sistant alloys than by any other means, say C. A. Murray and M. A. Furth of Pure Oil Company, in discussing corrosion prevention in a TCC gas concentration unit. Under present conditions of alloy supply we must have more data on means to extend the life of currently used metals. The presence of water, 5000 gal per day, in the process streams to the unit were found to be responsible mainly for corrosion, and the near-elimination of this water reduced drastically the amount of corrosion experienced, relieving the plant from costly shutdowns and replacement of equipment. This paper is presented elsewhere in this issue.

Hydrogen penetration into the body of steel in plant equipment is possible and is responsible for certain types of steel failures. This condition includes embrittlement, fissuring, and blistering. Atomic hydrogen, not that in molecular form, penetrates steel. At high temperatures hydrogen dissociates into atomic hydrogen that will attack steel containers. Atomic hydrogen is formed when steel corrodes and if no protective film is present will penetrate the steel, weakening it seriously. One of the best methods found so far to combat this problem is by thorough water washing of process streams to remove reactive agents that produce atomic hydrogen in contact with the steel surfaces.

Aluminum in refining equipment has high resistance to corrosion by sulfur, ammonia, and furfural, and is most useful in locations having these agents, say E. E. Kerns and W. E. Baker of Standard Oil Company of Ohio. As aluminum is anodic to most other metals in equipment construction it is vital that this be kept in mind when designing equipment to avoid galvanic corrosive action. Where coverings such as insulation may become damp, severe corrosion is found on aluminum surfaces. Atmospheric conditions where corrosive materials are present show little if any corrosive effects.

Two all-important phases of the fuels-and-engines correlation problem were given high runs in the Tulsa meeting. The spectacular trend toward the use of liquefied petroleum gases (LPG) in farm and other tractors, buses, trucks, and other heavy-duty automotive equipment called forth prophecies from R. C. Alden and collaborators, that by 1960 a million barrels per annum of LPG for automotive use may be expected. With a margin of 5 to 8 cents per gallon between gasoline and LPG (propane-butane) the trend to the use of LPG for these automotive heavy-duty uses may be expected to continue, say E. S. Corner and E. H. Berg of Standard Oil Development and Esso Standard Oil Company, New York City.

Space cannot permit even brief reference to the great group of 40 papers presented before the Tulsa mid-year meeting of the Refining Division of the API; the 16 papers on analytical procedures on spectrographic, spectrochemical, and many other phases of analytical development; on handling refinery waste waters and other waste products associated therewith, in which amazing strides have been made in the last decade; on corrosion prevention and the use of metals, chemicals, and procedures for this purpose, and the huge and increasingly serious problem of training technical men for refinery jobs in this all-important field of the industry. Suffice to say those papers and the discussion thereon were there, and made this, without doubt, the most outstanding meeting of the division, mid-year or otherwise. * * *

Seated in the hotel lobby are: Boyd Koepke, Aluminum Company of America; R. J. Schoenenberger, Podbielniak, Inc.; W. J. Podbielniak, winner of NGAA Hanlon Award, 1951, and Gordon T. Granger, Ralph M. Parsons Company.

NEWS

New Carbon Black Plant Takes Shape

The new $2,000,000 Continental Oil Black Company plant for the production of high abrasion furnace black from oil, has begun to take shape at Westlake, near Lake Charles, Louisiana. The new plant, with an annual capacity of 25,000,000 lb, is a joint enterprise of Continental Carbon Company and Continental Oil Company.

Rise in the use of synthetic rubbers, especially "cold rubber" has increased substantially the demand for high abrasion furnace black. It is anticipated the plant will be in production in June of this year. Output of the new plant will be distributed by Witco Chemical Company.

API Standards Available

The American Petroleum Institute, has announced that two new Standard samples are available, which may be obtained from Carnegie Institute of Technology, API, Department of Chemistry, Pittsburgh 13, Pa.

The following table gives the two compounds recently announced as API Standard samples:

Standard sample number*	Compound	Amount of impurity†	Volume of unit‡	Price per unit
		mole per cent	ml (liquid)	
1001-58	2, 2-Dimethyl-heptane	(0.20±0.15)*	5	$35
1002-58	2-Methyldecane	0.09±0.06	5	35

* The designation "-58" following the sample number indicates a sample of 5 ml sealed "in vacuum" in a special Pyrex glass ampoule with internal "break off" tip.

† The purity has been evaluated from measurements of freezing points in accordance with the method and procedure of the American Petroleum Institute Research Project 6, as described in J. Research Natl. Bureau Standards 35, 355 (1945), unless otherwise noted.

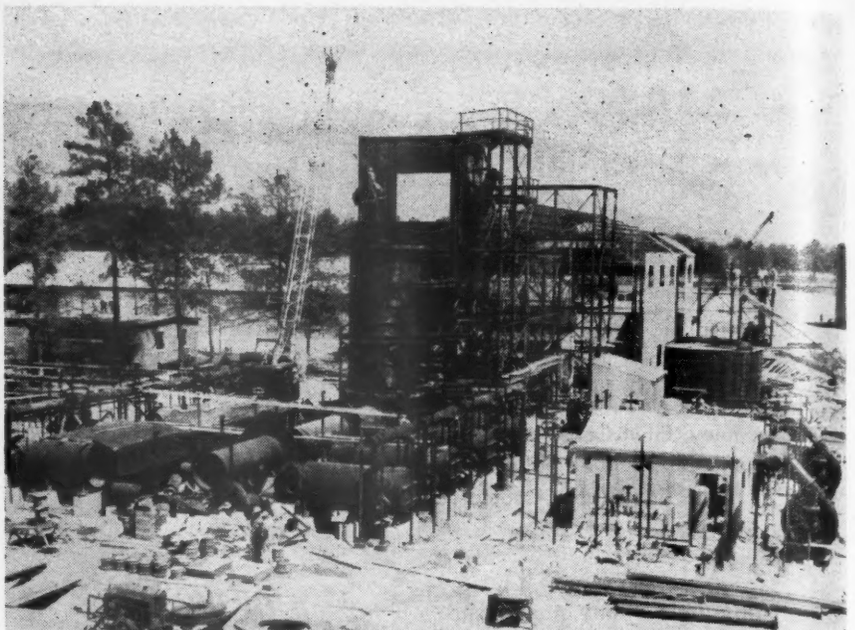
‡ Tolerance approximately ±10 per cent.

* Estimated.

A list of the 184 compounds available as API Standard samples on Jan. 1, 1951, may also be obtained.

Iran Cat Cracker Begins Operation

The Anglo-Iranian Oil Company's Fluid catalytic refining unit near Abadan, Iran, began its first run recently. The new catalytic cracking unit and gas-recovery plant were installed as a part of a project to improve the refinery's balance of white and black oils. The new fluid unit was completed at the end of March. Roughly 25,000 bbl of wax distillate will be used for the unit. It is expected that eventually input may be increased to about 35,000 bbl.



Constructing carbon black plant near Lake Charles, Louisiana.

Snell Presents Three Papers To World Petroleum Meet

Dr. Foster Dee Snell, president of Foster D. Snell, Inc., New York City firm of consulting chemists and chemical engineers, is presenting three papers before the Third World Petroleum Congress presently being held at The Hague. All three papers, written in collaboration with members of the Snell staff, are on different phases of detergents as they are produced from raw materials of the petroleum industry.

The first, prepared jointly with Lyman H. Allen, Jr., director of engineering, and Robert Sandler of that department, discusses detergency from a chemical engineering viewpoint.

The second, prepared with Irving Reich, discusses the advantages and disadvantages of synthetic detergents —called syndets by Snell. This paper covers the chemistry of petroleum-based syndets showing comparative values and uses for different types.

The third paper prepared jointly with John R. Skeen, director of market research, discusses surface-active agents from petroleum from a market research standpoint, past production, and possible future expansion.

Plan Australian Refinery

Shell Oil Company has announced plans for the building of a new refinery near Melbourne, Australia. The new refinery, which will have a capacity of 22,000 bbl daily, is expected to be completed by 1953. It is expected to run on crude from British Borneo, where the Royal Dutch-Shell organization has developed production now exceeding 100,000 bbl daily.

Gulf to Construct Research Laboratory

A new chemical research laboratory is being built at Gulf Oil Corporation's research center in nearby Harmarville, Pennsylvania. The building and equipment will cost an estimated $1,100,000; and, barring material hold-ups, it will be completed in about a year. Three sections of the Laboratories' Chemistry Division, devoted to product development, analysis, and organic synthesis, will occupy the new facilities. The quarters currently housing these activities will make available additional space for the physics, materials and production chemistry, and engineering divisions.

New Mexico Refinery Nears Completion

New Mexico Asphalt and Refining Company, Artesia, New Mexico, is nearing completion of a $2,500,000 expansion at its Artesia plant, A. R. Matthews, president, has announced. The program includes the installation of a thermofor catalytic cracking unit, catalytic-poly unit, feed preparation unit, and a gas recovery system.

Certificate of Cooperation Awarded to Shell Chemical

Shell Chemical Corporation was awarded a Marshall Plan Certificate of Cooperation recently by Mayor Vincent R. Impellitteri at ceremonies held at City Hall. The certificate was awarded in recognition of assistance rendered by Shell Chemical to teams of visiting foreign experts brought to the United States by ECA to study American techniques.

Refining Publications Available From API

The American Petroleum Institute's Division of Refining announces the availability of two new publications, viz.: 1, "Part IV—Low-Pressure Storage Tanks," of the *Manual of Recommended Practices for Refinery Inspections;* 2, *API Standard 600:* "API Standard on Flanged and Welding-End Steel Wedge-Gate and Plug Valves for Refinery Use."

The price of "Part IV—Low-Pressure Storage Tanks" is $1; and of *Standard 600* is $1.50. Parts I, II, and III of the refinery inspections manual are still available.

Standard 600 on flanged and welding-end steel wedge-gate and plug valves, just off the press, was first published as "tentative" in 1949. It has been slightly revised, and has been elevated to the status of full standard. These publications are available from the American Petroleum Institute, 50 West 50th Street, New York 20, N. Y.

Missouri Refinery Enlarged

Plans for expansion of refining capacity at the Sugar Creek, Missouri, refinery of Standard Oil Company (Indiana) to help meet the military and civilian demand for more and improved petroleum products were announced by Dr. M. G. Paulus, vice president in charge of manufacturing.

Preliminary construction work has already begun, he said, but the major construction activity will come later this year and next. It is anticipated that the expansion will be completed by the end of 1952, provided no delays are encountered in obtaining necessary construction materials.

The expansion program will increase the Sugar Creek refinery's capacity for processing crude oil from 38,000 to 68,000 bbl per day, according to Dr. Paulus. The major unit to be installed is a large combination crude-running and coking unit, which will be situated adjacent to the catalytic cracking and vapor recovery units installed at Sugar Creek in 1948.

API Hears Woman Scientist

The first woman scientist ever to deliver a technical paper before the American Petroleum Institute's refining section reported to that group recently on significant new discoveries about engine deposits—a problem of importance to both the automotive and petroleum industries and the motoring public. The lady chemist is Dr. Frances W. Lamb of the Ethyl Corporation Research Laboratories, a leading engine-fuel research center. The Ethyl Laboratories, situated in Detroit, Michigan, have long had the engine deposit problem under study, but it was the results of a special three-year project that Dr. Lamb discussed before the API's Division of Refining at its 16th mid-year meeting in Tulsa. Co-author of the paper, entitled "Formation of Engine Deposit Compounds by Solid-State Reactions," is Leonard M. Niebylski, also of Ethyl.

The importance of engine deposits and the causes and methods of control of such deposits are changing with changing engine conditions and the findings of only a few years ago are obsolete, recent studies reveal. Dr. Lamb said her study sheds new light on how and why deposits are formed. Dr. Lamb and her co-worker identified the actual compounds found in engine deposits and determined the principles by which their composition can be controlled.

Named ACS Director

M. H. Arveson of Chicago, technical director of the Indoil Chemical Company, a subsidiary of the Standard Oil Company (Indiana), has been elected a director-at-large of the American Chemical Society. Arveson was chosen by the national council of the society to fill the unexpired term of Dr. Edward C. Britton of the Dow Chemical Company, Midland, Michigan, who became an ex-officio member of the board of directors upon the recent election as president of the Society for 1952.

A former chairman of the society's Chicago section, Arveson has been active in society affairs nationally as well as locally for many years. He has been a member of the council since 1943 and has served on the council's policy committee since 1947.

Lubricants Demand Rises

Total demand for lubricants in the first 2 months of 1951 have increased 19.8 per cent over the 1950 period, according to a Bureau of Mines report. The demand rose to 8,863,000 bbl, compared with 7,397,000. The principal increase occurred in domestic demand, which rose to 6,654,000 bbl, compared with 5,214,000 in the year-earlier period, a gain of 27.6 per cent.

Alberta Crude to Sarnia

The first Alberta crude oil has been pumped into the tanks of Sarnia, Ontario, refinery. The dockside ceremony, attended also by representatives of the federal and Alberta governments and of western oil producers, marked the breaking of the distance barrier, which has kept Alberta oil within the prairies because of transportation costs. Sarnia will now draw on western fields for oil for refining and chemical industries.

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ALCOA Coiled Tubes ALUMINUM

Phillips to Build New Gasoline Plant

Phillips Petroleum Company will construct a natural gasoline products plant south of Midland, Texas. It will be known as Spraberry plant and will serve the Tex Harvey, Germania, and Driver areas of the flourishing Spraberry sand developments in Midland and Glasscock counties.

Phillips recently announced a new crude oil line to serve the same general area which will supply gas to the new plant. In addition a natural gasoline products line will connect with Phillips' Permian Basin gathering system, assuring the plant a steady rather than a seasonal outlet for its natural gasoline and LPG production. Negotiations are progressing to sell the surplus residue gas available at the plant and not otherwise used for lease fuel, development, and repressuring.

Outdoor Tank Insulation

The application of insulation and weatherproof finish on an outdoor storage tank in the Midwest illustrates the four steps in an effective technique for insulating large, cylindrical vessels. In the photo, the tank, which will operate at 270 F, is being insulated with 1½-in. thick mineral wool

Men working to insulate tank.

blankets, in 24 × 48-in. sections, covered with expanded metal lath on one side and wire netting on the other.

From bottom to top in the photo, the four steps are:

(1) Mineral wool blankets, metal lath covering on the outside, are tightly butted together and secured to the tank by 1-in. galvanized iron bands encircling the tank on 9-in. centers.

(2) A single ¾-in. layer of insulating cement is trowelled into the metal lath covering.

(3) 1-in. mesh wire netting is stretched over the dry cement.

(4) A coat of asphalt mastic, ⅛-in. thick when dry, is trowelled into the wire netting and smoothly surfaced to finish the tank insulation.

The insulating materials and steps illustrated are designed to maintain the temperature of the tank contents under all weather conditions with minimum maintenance and repair.

Utah Refinery Unit Planned

Phillips Petroleum Company has announced that it will build an 8000-bbl catalytic cracking unit at its refinery in Woods Cross, Utah. Construction is to begin in August, and the unit is scheduled for completion in May 1952. Contract has been let to the Fluor Corporation, Los Angeles, California.

Koppers to Reactivate Fourth Butadiene Plant

Government authorities have authorized the chemical division of Koppers Company, Inc., to reactivate the fourth and last butadiene unit of the government-owned plant at Kobuta, Pennsylvania, it was announced by Dan M. Rugg, vice president and general manager of the Koppers division.

This unit, like the others, had been in stand-by condition since World War II. After the Korean emergency arose, Koppers was asked to reactivate two units. Later a third unit was ordered reactivated and now the fourth.

DuPont Discovers New Silica Grease

The Du Pont Company's chemical department has announced discovery of a sand-derived material called GS-199S silica to thicken oil in making grease. The new form of silica, developed in Du Pont laboratories comes in the form of balls less than a millionth of an inch in diameter—so tiny, in fact, that when magnified 25,000 times they still appear scarcely larger than pin points. The new Du Pont silica floats on water, due to special treatment of the minute particles.

New Cat Cracker at El Paso

The Standard Oil Company of Texas will install a Houdriflow cat cracking unit at its El Paso, Texas, refinery, Brigadier General D. N. Hauseman, president of Houdry Process Corporation announced. The new unit will have a design capacity of 11,000 bbl per day of oil. Construction of the unit will be carried out by the Catalytic Construction Company, of Philadelphia.

Building World's Largest Flasher

Construction of the world's largest vacuum flasher—a 55,000 bbl per day unit for the Standard Oil Company of California—is now more than 75 per cent complete, according to The M. W. Kellogg Company, refinery and chemical engineers of New York City, which is erecting it.

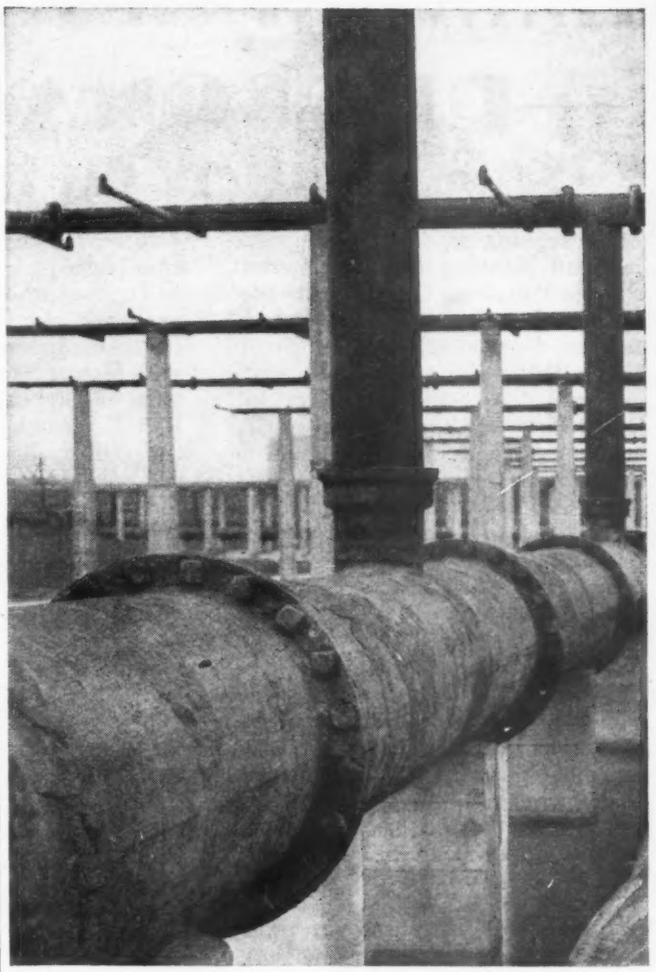
Scheduled to go on stream by the middle of July, the unit is designed to provide approximately 30,000 bbl of feed each day for the existing catalytic cracking unit at Richmond, Virginia. The cracker is being revamped during a general modernization program at this refinery. Asphalt, which comes off the flasher as a bottom product, will be charged to visbreakers to produce gasoline and high quality fuel oil.

According to Kellogg, the main tower in the flasher will have an overall height of approximately 100 ft and a maximum diameter of 27 ft. Its design capacity is believed to exceed by 15 per cent the largest vacumu unit currently in operation.

Shell to Build Biggest Australian Refinery

Australia's largest crude oil distillation plant will be built at Geelong, Victoria, by Shell Company of Australia, Ltd. To be completed by the end of 1953, the 250-acre plant will have an eventual output of 1,000,000 tons annually. Prime purpose of the plant will be to reduce Australia's dollar shortage. Feed stock will be obtained from British Borneo, which is a nearly 100 per cent sterling source.

Plant output will include the full range of petroleum products. Annual volume will initially equal 750,000 tons. The output will include 163,200,000 gal of gasoline, 45,600,000 gal of fuel oil, and 27,600,000 gal of diesel oil.



AN ECONOMY FACTOR
IN REFINERY OPERATION

Proved long life and stubborn resistance to corrosion make cast iron pipe a contributing factor in lowering plant maintenance per barrel of crude. Replacing shorter-lived pipe with cast iron pipe has demonstrated this in many refineries. Cost per term of service decreases. Interference with production, caused by frequent replacements, ceases to be a headache. Cast iron pipe works hand-in-glove with plant management to keep maintenance cost down in many refinery operations. Available with bell-and-spigot, plain end and flanged, or with standardized mechanical joints. Cast Iron Pipe Research Association, Thomas F. Wolfe, Engineer, 1015 Peoples Gas Bldg., Chicago 3, Illinois.

CAST IRON PIPE
FOR LONG LIFE AND ECONOMY

—PERSONALS—

▸ **W. H. Creel,** formerly in charge of the refining department's engineering and planning and development, Phillips Petroleum Company, has been appointed assistant manager of the refining department. He will report to **C. C. Tate,** who was recently made manager of the department. Creel will be in charge of all manufacturing and engineering activities carried on in Bartlesville.

W. A. McCarthy, superintendent of the Kansas City, Kansas, refinery for the past four years, has been appointed staff assistant to the manager, with his office in Bartlesville, Oklahoma.

Succeeding McCarthy, is **H. G. Fair,** who has been assistant superintendent of the Kansas City refinery. **L. G. Molique,** who has been in charge of planning and development in the department's aviation fuels division in Bartlesville, has been named assistant superintendent of the Kansas City refinery.

▸ **G. G. Oberfell,** retired vice president of Phillips Petroleum Company, Bartlesville, Oklahoma, was honored recently with the Distinguished Service Award of the Liquefied Petroleum Gas Association. The citation, which carries with it an honorary life membership in LPGA, was presented by Mark Anton, president, Suburban Propane Gas Company, Whippany, New Jersey, a past president of the Association, at the organization's 20th anniversary convention at the Stevens Hotel. Oberfell was given the award because of his many research and scientific contributions to the advancement of the LP-gas industry. Earlier recipients have been Anton and A. N. Kerr, president, Imperial Gas Company, Los Angeles, California.

A pioneer in the LP-gas industry and nationally known authority on petroleum research, Oberfell established Phillips research and development department when he joined the company in 1925. Oberfell retired from Phillips last year and is now serving as a consultant for the Reconstruction Finance Corporation in Washington, D. C.

▸ **Dr. Charles Allen Thomas** has been elected president of Monsanto Chemical Company. Thomas was prominently identified with the production of the atomic bomb and co-author of a plan for control of neuclear weapons. The 51-year-old scientist replaces **William M. Rand,** who retires under the company pension plan.

Thomas, who has been Monsanto's executive vice president since 1947, began his industrial career with General Motors, aiding in the development of ethyl gasoline and later established research laboratories in Dayton, Ohio. The laboratories were acquired by Monsanto in 1936 and Thomas became the company's research director.

Fred C. Hanker, Jr.

▸ **Fred C. Hanker, Jr.,** has been named assistant to the president in the Catalytic Construction Company, Philadelphia, Pennsylvania. Hanker has background of petrochemical engineering and operations, having been associated with the petroleum industry since 1935. Prior to joining Catalytic, Hanker was a process engineer with Standard Oil Development Company, and during the early 1940's was active in design and installation of aviation gasoline facilities for Standard Oil Company (New Jersey) interests. He was graduated from the University of Pittsburgh as a chemical engineer in 1935.

▸ **Dr. Walter J. Podbielniak** has been granted the Hanlon award, highest honor in the natural gasoline industry. Podbielniak, head of Podbielniak, Inc., Chicago, Illinois, is the 15th recipient of the Hanlon Award, which was awarded at the 30th annual convention of the Natural Gasoline Association of America. James E. Pew, Sun Oil Company, presented the award citing Podbielniak's "early development of practical analytical apparatus and his continuous efforts through the years to improve its accuracy and efficiency until it has become the most valuable single tool in the analysis of gas and liquid hydrocarbons."

▸ **Warren A. Beman,** staff member in charge of textile work for the chemical products division of the Socony-Vacuum Oil Company, Inc., has been appointed to direct chemical products development for the company. A primary function of Socony-Vacuum's new activity will be to coordinate the company's development program on all chemical products by working closely with the research and development heads of other leading companies in the paper, textile, plastic, rubber, and chemical fields. A chemical engineering graduate of Purdue University, Beman also attended the graduate school of the Polytechnic Institute of Brooklyn. Before joining Socony-Vacuum's executives offices, he worked in refinery engineering.

▸ **W. C. Hewitt,** manager of Plains butadiene plant, near Borger, Texas, for Phillips Chemical Company, wholly-owned subsidiary of Phillips Petroleum Company, has been placed on special assignments in connection with the national synthetic rubber program. **A. B. Leonard,** superintendent of Cactus plant, near Etter, Texas, has succeeded Hewitt as manager of Plains plant.

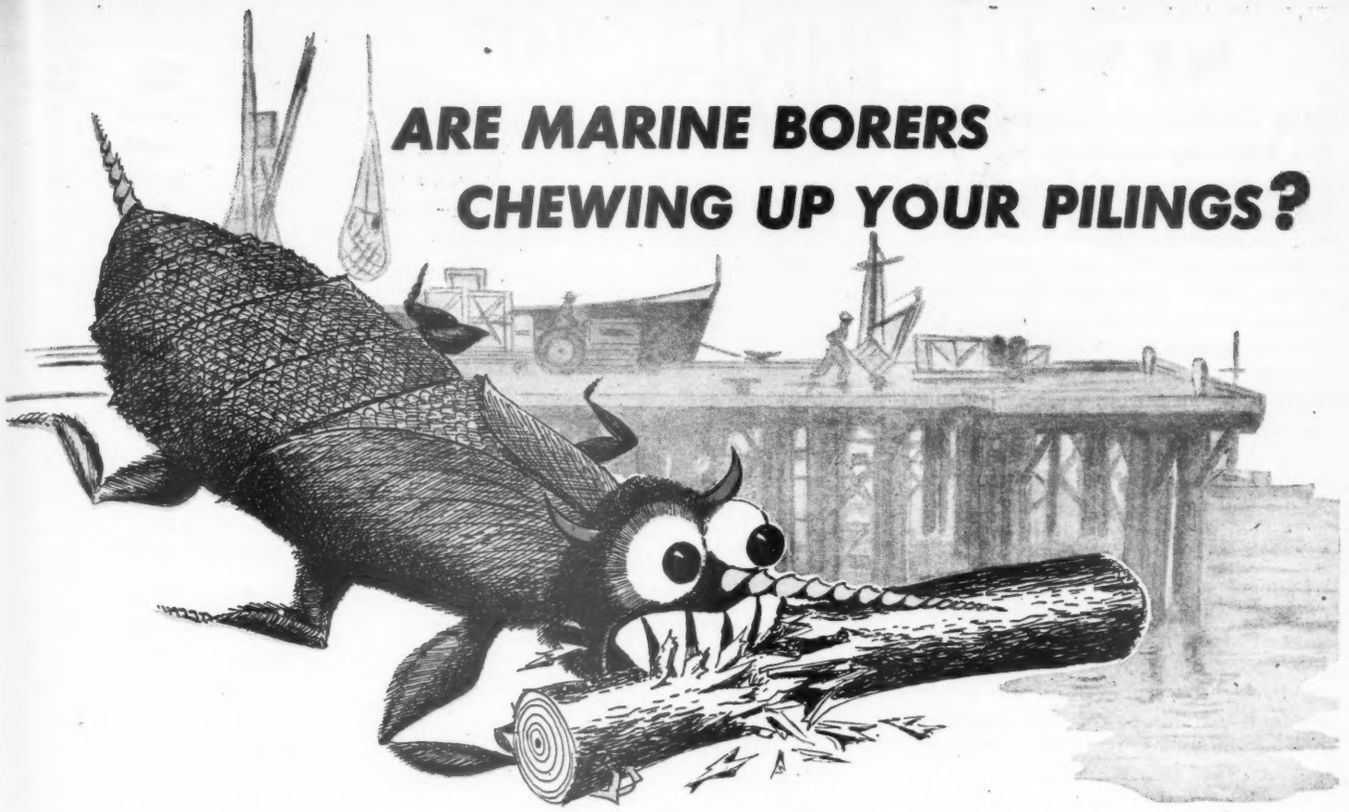
T. M. Hipp, assistant of Cactus plant, has been promoted to superintendent of Cactus plant. **C. W. Foreman,** manufacturing superintendent at Cactus plant has been promoted to assistant superintendent at Cactus.

E. C. Ayres, superintendent of Adams Terminal, near Houston, Texas, has been promoted to chief process engineer of Phillips Chemical Company. **R. G. Rhodes,** process superintendent at Plains plant, has been promoted to superintendent of Adams Terminal. **A. F. Legatski,** process superintendent at Cactus plant, has been named superintendent of the sulfur plant, which will be constructed in West Texas.

▸ **G. W. Huldrum, Jr.,** manager, agricultural products department, Shell Chemical Corporation, Western Division, will become assistant sales manager, Western division.

M. G. Folsom will become manager of a new fertilizer department and **T. A. Moncure,** manager of the agricultural products department.

The agricultural products department, western division, as now constituted, handles fertilizers, insecticides, and allied materials. In order to provide for more efficient operation, these products will be handled in two departments in the future—the fertilizer department handling ammonium sulfate and agricultural ammonia and the agricultural products department handling insecticides, herbicides, fungicides, and fumigants.



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Starve them with steel—plus NATIONAL graphite ground anodes!

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- **Complete and sure protection in sea water—indefinitely**
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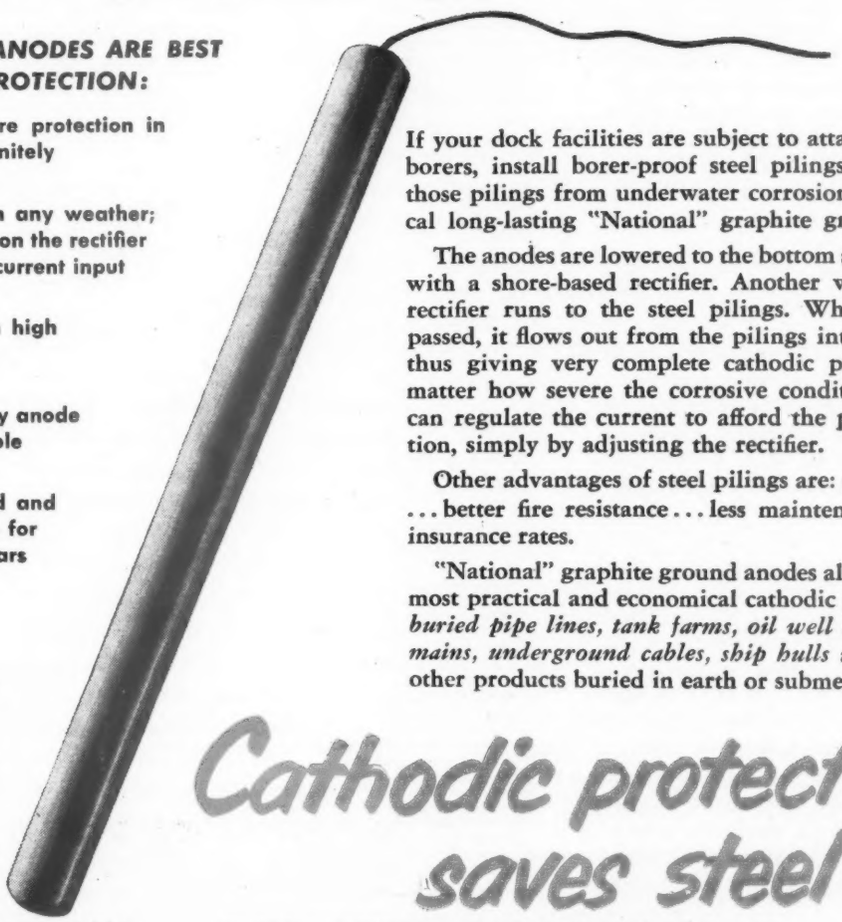

If your dock facilities are subject to attack by marine borers, install borer-proof steel pilings, and protect those pilings from underwater corrosion by economical long-lasting "National" graphite ground anodes.

The anodes are lowered to the bottom and connected with a shore-based rectifier. Another wire from the rectifier runs to the steel pilings. When current is passed, it flows out from the pilings into the water—thus giving very complete cathodic protection. No matter how severe the corrosive conditions are, you can regulate the current to afford the proper protection, simply by adjusting the rectifier.

Other advantages of steel pilings are: more strength ... better fire resistance ... less maintenance ... lower insurance rates.

"National" graphite ground anodes also provide the most practical and economical cathodic protection for *buried pipe lines, tank farms, oil well casings, water mains, underground cables, ship hulls* and dozens of other products buried in earth or submerged in water.

Cathodic protection saves steel!

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To obtain more information on products advertised see page E-45

NEWS

DPA Certificates Stopped On Refining Facilities

The Petroleum Administration for Defense has issued an order stating that no more emergency amortization certificates covering basic refining facilities will be approved except those already being processed on April 30. The new policy, which applies to basic refining facilities only, apparently was dictated because approved and pending applications will provide the 1,000,000-bbl-a-day increase set by PAD as its goal for the defense program by the end of 1953.

The ruling does not apply to facilities for producing special military products, such as aviation gasoline and aviation alkylate, or special petroleum products needed in the mobilization program, such as aromatics or butylenes, nor will it apply to other segments of the petroleum industry, such as oil or gas pipe lines or storage facilities.

Certificates authorized companies to deduct from taxable income from 40 to 100 per cent of the cost of the facilities allowed during the next 5-year period. Normal period of amortization of facilities allowed by the Bureau of Internal Revenue for tax purposes is 20 to 25 years.

Latest projects include:

Basic refining facilities, recommended for 75 per cent amortization:

Kansas—the Derby Oil Company, Wichita, $2,606,000; Standard Oil Company (Indiana), Neodesha, $7,810,000, and Kanotex Refining Company, Arkansas City, $2,437,423.

Oklahoma — Mercury Oil Refining Company, Oklahoma City, $3,195,000; Cities Service Oil Company, Ponca City, $6,500,000.

Also Standard Oil Company (Indiana), Sugar Creek, Missouri, $21,170,000.

Aviation alkylate and special alkylation feed facilities recommended for 100 per cent accelerated amortization:

Standard Oil Company (Indiana) Neodesha, Kansas, $2,213,000; Sunray Oil Corporation, Duncan, $1,750,866.

At right is a table listing earlier projects for which certificates were granted earlier.

Chemistry Scholarships

The Socony-Vacuum Oil Company, Inc., has awarded $2000 to Ohio State University, Columbus, Ohio, for continuation of a fellowship in physical chemistry. A total of 20 fellowships will be supported by Socony-Vacuum during the 1951-52 academic year at colleges and universities throughout the country at a total cost of $40,000.

Name of company Location of facilities	Product or Service	Amount applied for	Amount eligible	Percentage certified
Mathieson Hydro-carbon Chemical Corp. Doe Run, Kentucky	iso-butane	$19,000,000	$18,980,095	75
Frontier Chemical Co. of Kansas, Inc. Sedgwick, Kansas	chlorine, hydrochloric acid	1,467,800	1,432,800	50
The Dow Chemical Company Midland, Michigan	chlorine, caustic soda	2,600,000	2,600,000	50
The Sherwin-Williams Company Chicago, Illinois	refined naphthalene	274,060	274,060	55
Monsanto Chemical Company Texas City, Texas	acrylonitrile, hydrogen cyanide	25,633,000	25,633,000	50
Jones and Laughlin Steel Corp. Aliquippa, Pennsylvania	pipe and tubing	1,533,250	1,377,000	60
Allegheny Ludlum Steel Corp. Watervliet, New York	stainless steel	3,200,000	3,200,000	75
Sun Oil Company Marcus Hook, Pennsylvania	benzene, toluene	8,380,000	8,380,000	85
Jones and Laughlin Steel Corp. Pittsburgh, Pennsylvania	steel plates, sheets, strip	9,392,743	3,777,987	60
Cities Service Oil Company Ponca City, Oklahoma	gasoline, fuel oil	6,500,000	6,500,000	75
Phillips Oil Company Borger, Texas	aviation alkylate, gasoline and diesel fuel	15,573,700	15,573,700	75
Ashland Oil and Refining Company St. Elmo and Wood River, Illinois	gasoline, kerosine	725,000	665,000	75
Western States Refining Company North Salt Lake, Utah	gasoline	1,413,250	1,092,700	75
Sinclair Refining Company Houston, Texas	normal butylenes	27,000,000	27,000,000	75
Delhi Gasoline Plant, Sun Oil Company Delhi, Louisiana	iso-butane	238,497	238,497	85
Frontier Natural Gasoline Company Loco Hills, New Mexico	natural gasoline	703,986	703,986	75
Standard Oil Company (Indiana) Sugar Creek, Missouri	gasoline, kerosine	21,170,000	21,170,000	75
Premier Petroleum Company Fort Worth, Texas	gasoline	650,000	650,000	75
Gulf Oil Corporation Port Arthur, Texas	ethylene	15,427,000	15,427,000	80
Standard Oil Company of Indiana Whiting, Indiana	components for aviation gasoline	938,500	938,500	100
Continental Oil Company Lake Charles, Louisiana	gasoline, components, by-products	23,820,150	23,820,150	80
Kanotex Refining Company Arkansas City, Kansas	high octane gasoline	2,347,423	2,347,423	75
Jones and Laughlin Steel Corp. Pittsburgh, Pennsylvania	steel	379,600	379,600	75
Jones and Laughlin Steel Corp. Pittsburgh, Pennsylvania	steel ingots	104,600	101,900	75
Bloom Engineering Company, Inc. Pittsburgh, Pennsylvania	equipment for industrial furnaces, pipe insulation material	165,080	157,080	80
Ethyl Corporation Houston, Texas	anti-knock compounds	45,000,000	41,135,000	85
Ethyl Corporation Baton Rouge, Louisiana	anti-knock compounds	4,041,000	4,041,000	75
Ethyl-Dow Chemical Company Freeport, Texas	ethylene dibromide	8,185,000	8,185,000	100
General Motors Corp. Cleveland, Ohio	diesel engine	1,744,282	1,744,282	75
Worthington Pump and Machinery Corp. Harrison, New Jersey	pumps	285,906	285,906	85
Dow Corning Corporation Midland, Michigan	silicone, rubber	1,460,000	1,460,000	75
Lufkin Foundry and Machinery Company Lufkin, Texas	oil pumping units	100,000	100,000	75
Seaboard Refractories Raritan Township, New Jersey	mullite, silicon, carbide and clay refractories	174,700	174,700	85
Fitzgibbon Boiler Company, Inc. Oswego, New York	hulls for tanks	1,750,000	1,750,000	75
Minneapolis-Honeywell Regulator Company Philadelphia, Pennsylvania	instruments for measuring recording	750,000	731,000	75
Powers Regulator Company Skokie, Illinois	process control apparatus valves	2,378,390	1,588,390	75
Crouse-Hinds Company Syracuse, New York	conduit fittings	5,098,985	5,098,985	75
Sun Oil Company Marcus Hook, Pennsylvania	aviation gasoline	2,577,145	2,577,145	100
Taylor Refining Company Corpus Christi, Texas	butanes, gasoline and oil	5,057,493	5,057,493	75
The Kellex Corporation Summit, New Jersey	research, development, and construction services	285,000	260,000	75
Aluminum Company of America Port Lavaca, Texas	primary aluminum	43,564,618	5,209,375	80
C. A. Dunham Company Marshalltown, Iowa	steam traps and valves	109,418	109,418	75
Standard Oil Company of Indiana Neodesha, Kansas	gasoline	10,029,000	10,029,000	80
Standard Oil Company of Indiana Whiting, Indiana	aviation gasoline	2,327,500	2,327,500	100
Friez Instrument Division Towson, Maryland	measuring instruments	93,861	93,861	85
Carroll B. Fulton and William H. Olmstead San Antonio, Texas	aviation gasoline	12,000,000	11,925,000	80
U. S. Rubber Company Passaic, New Jersey	hose	86,742	86,742	75
Brown and Root, Inc. Houston, Texas	rebuilding tanks	329,933	329,933	75
Cameron Iron Works, Inc. Houston, Texas	forged and rough machined beech rings	2,915,417	2,915,417	75
Ashland Oil and Refining Company Canton, Ohio	gasoline, butane, jet fuels	3,870,000	3,870,000	75
Premier Petroleum Company Fort Worth, Texas	jet fuel, butane, gasoline	3,580,000	3,580,000	75
Koppers Company, Inc. Petrolia, Pennsylvania	resorcinol	617,000	617,000	50
SKF Industries, Inc. Shippensburgh, Pennsylvania	roller, ball bearings, lock-nuts	902,103	886,103	85
California Refining Company Perth Amboy, New Jersey	gasoline fuels	32,950,583	32,950,583	80
Ingersoll Steel Division, Borg-Warner Corp. New Castle, Indiana	steel ingots	562,368	562,368	75
Pacific Moulded Products Company Los Angeles, California	research (rubber and rubber synthetics)	5,609	5,609	75
Lukens Steel Company Coatsville, Pennsylvania	steel fabrication and assembly	142,000	142,000	60

Too Many Pipe Lines?

ARE too many pipe lines being constructed? The controversial subject of whether natural gas reserves are being depleted too rapidly was a live topic at the annual meeting of the Natural Gas Department of the American Gas Association, as it has been at other industry gatherings and elsewhere. Admittedly, expansion of the gas industry has been greater within the last few years than at any time in its history. Numerous long cross-country pipe lines have been laid to take gas principally from Texas, Kansas, and Louisiana to industrial centers of the East and North. Considerable concern has been expressed by state regulatory bodies, some of whom feel that their states are being drained of an irreplaceable natural resource, which may be sorely needed at some later time. Whether in agreement with this outlook or in direct disagreement, it must be acknowledged that Paul Kayser, president of the El Paso Natural Gas Company, presented an excellent case for the latter cause in his address before the AGA.

There are in excess of 26 years' proved reserves of natural gas, he pointed out; but, further than that, the rate of discovery of reserves exceeds consumption each year by more than double the consumption. Putting it concretely, "the last 5-year period has been the period of greatest expansion in the history of the natural gas business and yet during that period the proved reserves of natural gas, after consumption, have risen from 160 trillion cubic feet to 185 trillion cubic feet."

Thus, he reasons, and justifiably, that reserves will last much longer than present proved reserves indicate, due to a constant increase in reserves as a result of new discoveries and revised estimates on existing fields.

To those who advocate the manufacture of synthetic gas from coal and shale and the conserving of the natural product, his answer is that in the distant future when reserves may become exhausted, the system of pipe lines now being created will be available to carry the synthetic product. This, he thinks, is further justification for the rapid construction of gas pipe lines.

More Steel For Line Pipe?

J. E. GOBLE, president of the National Tube Company, presented some facts and figures on steel production to those in attendance at the American Gas Association annual meeting. His words were of particular interest in view of the difficulty many are having in procuring line pipe. The steel industry's annual ingot capacity today stands at 104,000,000 tons. This is approximately 100 per cent more ingot steel than was produced by the American steel industry in 1939, when World War II was starting, and expansion is going forward that will give a capacity of 118,000,000 tons by the end of 1952.

Specifically of interest to the gas pipe line industry, he said: "Regardless of controls, if the international situation does not change to the extent that all present considerations are upset, steel will be made available by the authorities for transmission pipe line production in amounts such that the 1950 production rate of 2,425,000 tons will be exceeded in 1951 and 1952."

—F. H. L.

Leaders in Pipe Protection for a Quarter Century

HILL, HUBBELL *Announces*

A New Pipe Protection Plant in the Chicago Area

Hill, Hubbell's new steel pipe coating and wrapping plant, located in Hammond, Indiana, will begin operation June 15, 1951.

This central location is in the heart of the vast mid-western steel pipe producing area which includes East Chicago, Gary, Indiana Harbor, Milwaukee and South Chicago.

Customers in the west and southwest can now take advantage of the Hill, Hubbell process with faster deliveries.

Our new facilities will include "stop-over privileges" for pipe to be coated and wrapped in transit on minimum freight rates.

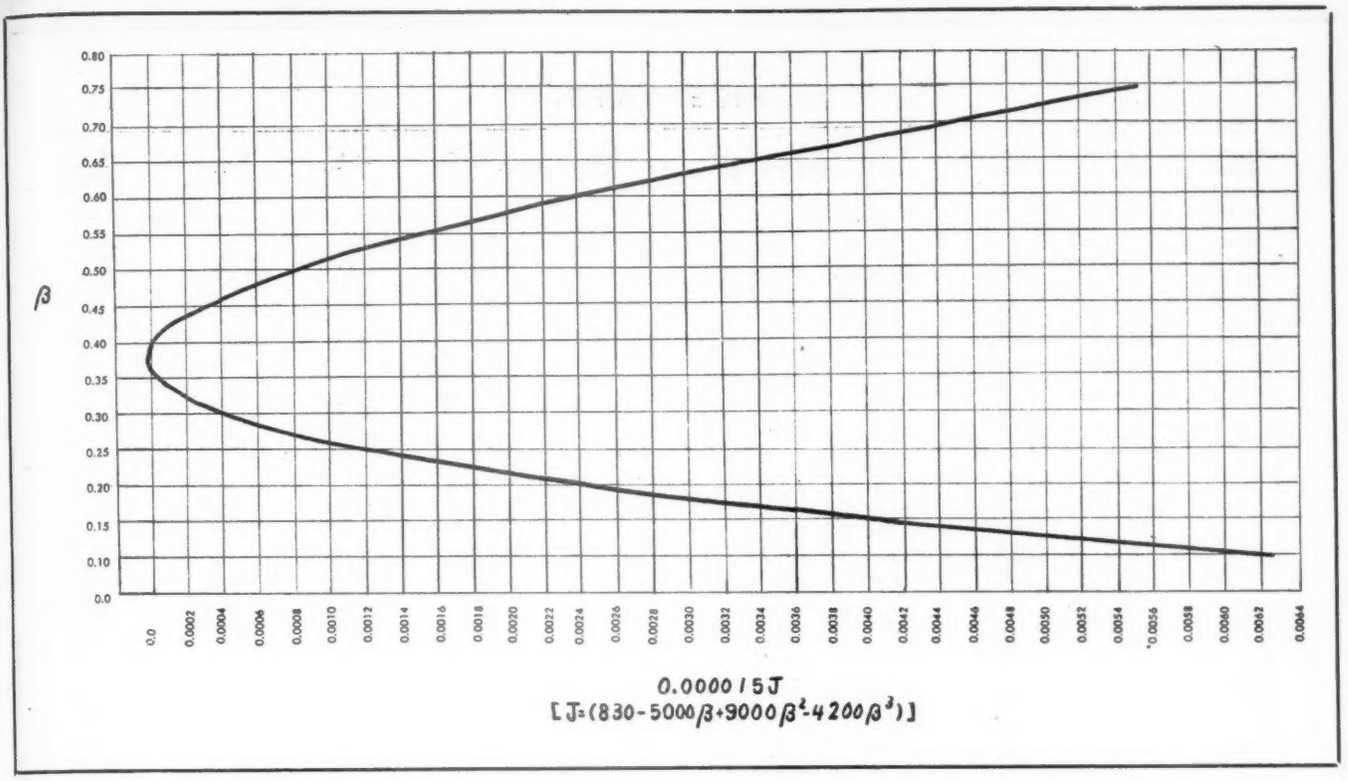
The new plant has ample space for storage of pipe to be coated and wrapped as you need it.

If you'd like to know more about this new plant, and the advantages of factory coated pipe, please write —

Hill, Hubbell and Company

Division of GENERAL PAINT CORPORATION

Headquarters: 3091 Mayfield Road, Cleveland 18, Ohio



Calculation of Orifice Meter Coefficients

Tabulation of values includes pipe sizes from 2 in. through 24 in.—Curves further simplify and expedite calculations.

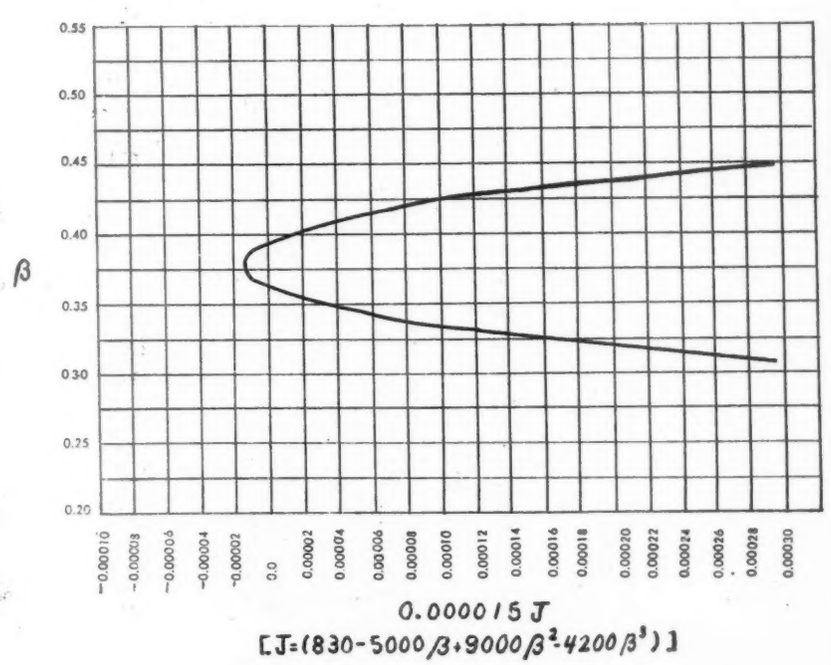
J. W. J. BERCHER

The accompanying tabulation of values of terms in the AGA formulae for determining the value of the coefficient of discharge, K_o, and the curves, are intended to reduce the time required to set up the coefficient for an orifice meter setting.

The tables are made up of the various terms in the formula for K_o, for pipe taps and for flange taps, together with values of B and of 0.000015B. All terms depending upon the value of D_1, the inside diameter of the meter run, will be found for pipe sizes ranging from 2 in. nominal to 24 in. od.

The curves may be used to determine the value of 0.000015J, where J is the value of $(830 - 5000\beta + 9000\beta^2 - 4200\beta^3)$. The use of this term is explained below.

The well known AGA formulae for



EXCLUSIVE

PIPE TAPS

Nominal pipe size	Schedule number	Inside Diameter	Wall thickness	$0.5925+\frac{0.0182}{D_1}$	$0.44-\frac{0.06}{D_1}$	$0.935+\frac{0.225}{D_1}$	$\frac{1.43}{\sqrt{D_1}}$	$\frac{875}{D_1}+75$ (B')	$\frac{15\ B'}{10^6}$
2	40	2.067	0.154	0.60130	0.41097	1.0438	0.99464	498.32	0.00747
	....	2.041	0.167	0.60142	0.41060	1.0452	1.0010	503.71	0.00756
	....	2.000	0.188	0.60160	0.41000	1.0475	1.0112	512.50	0.00769
	80	1.939	0.218	0.60189	0.40906	1.0510	1.0269	526.26	0.00789
	....	1.875	0.250	0.60221	0.40800	1.0550	1.0443	541.67	0.00812
	....	1.750	0.312	0.60290	0.40572	1.0636	1.0810	575.00	0.00862
	160	1.689	0.343	0.60328	0.40448	1.0682	1.1003	593.06	0.00890
	....	1.503	0.436	0.60461	0.40008	1.0847	1.1664	657.17	0.00986
2½	40	2.469	0.203	0.59987	0.41570	1.0261	0.91007	429.39	0.00644
	....	2.441	0.217	0.59996	0.41542	1.0272	0.91528	433.46	0.00650
	80	2.323	0.276	0.60033	0.41417	1.0319	0.93823	451.67	0.00678
	160	2.125	0.375	0.60106	0.41176	1.0409	0.98097	486.76	0.00730
	....	1.771	0.552	0.60278	0.40612	1.0620	1.0746	569.07	0.00854
3	....	3.250	0.125	0.59810	0.42154	1.0042	0.79322	344.23	0.00516
	....	3.204	0.148	0.59818	0.42027	1.0052	0.79890	348.10	0.00522
	....	3.124	0.188	0.59832	0.42079	1.0070	0.80906	355.09	0.00533
	40	3.068	0.216	0.59843	0.42044	1.0083	0.81641	360.20	0.00540
	....	3.018	0.241	0.59853	0.42012	1.0096	0.82314	364.93	0.00547
	....	2.992	0.254	0.59858	0.41995	1.0102	0.82671	367.45	0.00551
	....	2.922	0.289	0.59873	0.41947	1.0120	0.83656	374.45	0.00562
	80	2.900	0.300	0.59878	0.41931	1.0126	0.83972	376.72	0.00565
	....	2.875	0.312	0.59883	0.41913	1.0133	0.84337	379.35	0.00569
	....	2.687	0.406	0.59927	0.41767	1.0187	0.87237	400.64	0.00601
	160	2.626	0.437	0.59943	0.41715	1.0207	0.88245	408.21	0.00612
	....	2.300	0.600	0.60041	0.41391	1.0328	0.94291	455.43	0.00683
3½	....	3.744	0.128	0.59736	0.42398	0.99510	0.73904	308.71	0.00463
	....	3.732	0.134	0.59738	0.42392	0.99529	0.74023	309.46	0.00464
	....	3.704	0.148	0.59741	0.42380	0.99574	0.74302	311.23	0.00467
	....	3.624	0.188	0.59752	0.42344	0.99709	0.75118	316.45	0.00475
	40	3.548	0.226	0.59763	0.42309	0.99842	0.75918	321.62	0.00482
	....	3.438	0.281	0.59779	0.42255	1.0004	0.77123	329.59	0.00494
	80	3.364	0.318	0.59791	0.42216	1.0019	0.77966	335.11	0.00503
	....	3.312	0.344	0.59800	0.42188	1.0029	0.78576	339.19	0.00509
	....	3.062	0.469	0.59844	0.42040	1.0085	0.81721	360.76	0.00541
	....	2.728	0.636	0.59917	0.41801	1.0175	0.86579	395.75	0.00594
4	....	4.244	0.128	0.59679	0.42586	0.98802	0.69414	281.17	0.00422
	....	4.232	0.134	0.59680	0.42582	0.98817	0.69512	281.76	0.00423
	....	4.216	0.142	0.59682	0.42577	0.98837	0.69805	282.54	0.00424
	....	4.170	0.165	0.59686	0.42561	0.98896	0.70027	284.83	0.00427
	....	4.124	0.188	0.59691	0.42545	0.98956	0.70417	287.17	0.00431
	....	4.090	0.205	0.59695	0.42533	0.99001	0.70709	288.94	0.00433
	40	4.026	0.237	0.59702	0.42510	0.99089	0.71269	292.34	0.00438
	....	4.000	0.250	0.59705	0.42500	0.99125	0.71500	293.75	0.00441
	....	3.958	0.271	0.59710	0.42484	0.99185	0.71878	296.07	0.00444
	....	3.938	0.281	0.59712	0.42476	0.99214	0.72060	297.19	0.00446
	....	3.900	0.300	0.59717	0.42462	0.99269	0.72411	299.36	0.00449
	....	3.876	0.312	0.59720	0.42452	0.99305	0.72635	300.75	0.00451
	80	3.826	0.337	0.59726	0.42432	0.99381	0.73108	303.70	0.00456
	....	3.750	0.375	0.59735	0.42400	0.99500	0.73845	308.33	0.00462
	120	3.626	0.437	0.59752	0.42345	0.99705	0.75097	316.31	0.00474
	....	3.500	0.500	0.59770	0.42286	0.99929	0.76437	325.00	0.00488
	160	3.438	0.531	0.59779	0.42255	1.0004	0.77123	329.51	0.00494
	....	3.152	0.674	0.59827	0.42096	1.0064	0.80546	352.60	0.00529
5	40	5.047	0.258	0.59611	0.42811	0.97958	0.63653	248.37	0.00372
	....	4.859	0.352	0.59624	0.42765	0.98131	0.64873	255.08	0.00383
	80	4.813	0.375	0.59629	0.42751	0.98186	0.65182	257.22	0.00386
	....	4.688	0.437	0.59638	0.42720	0.98299	0.66045	261.65	0.00392
	120	4.563	0.500	0.59649	0.42685	0.98431	0.66944	266.76	0.00400
	160	4.313	0.625	0.59672	0.42609	0.98717	0.68857	277.87	0.00417
	....	4.063	0.750	0.59698	0.42523	0.99038	0.70944	290.36	0.00436
6	....	6.287	0.169	0.59539	0.43046	0.97079	0.57031	214.18	0.00321
	....	6.265	0.180	0.59540	0.43042	0.97091	0.57131	214.66	0.00322
	....	6.249	0.188	0.59541	0.43040	0.97101	0.57204	215.02	0.00322
	....	6.187	0.219	0.59544	0.43030	0.97137	0.57490	216.42	0.00325
	....	6.125	0.250	0.59547	0.43020	0.97173	0.57781	217.86	0.00327
	....	6.071	0.277	0.59550	0.43012	0.97206	0.58037	219.13	0.00329
	40	6.065	0.280	0.59550	0.43011	0.97210	0.58066	219.27	0.00329
	....	5.875	0.375	0.59560	0.42979	0.97330	0.58997	223.94	0.00336
	80	5.761	0.432	0.59566	0.42958	0.97406	0.59578	226.88	0.00340
	....	5.625	0.500	0.59574	0.42933	0.97500	0.60294	230.56	0.00346
	120	5.501	0.562	0.59581	0.42909	0.97590	0.60970	234.06	0.00351
	160	5.189	0.718	0.59601	0.42844	0.97836	0.62776	243.62	0.00365
	....	4.897	0.864	0.59622	0.42775	0.98095	0.64620	253.68	0.00380
8	....	8.309	0.158	0.59469	0.43278	0.96208	0.49609	180.31	0.00270
	....	8.295	0.165	0.59469	0.43277	0.96212	0.49651	180.48	0.00271
	....	8.249	0.188	0.59471	0.43273	0.96228	0.49789	181.07	0.00272
	....	8.219	0.203	0.59471	0.43270	0.96238	0.49880	181.46	0.00272
	....	8.187	0.219	0.59472	0.43267	0.96248	0.49977	181.88	0.00273
	....	8.149	0.238	0.59473	0.43264	0.96261	0.50094	182.38	0.00274
	20	8.125	0.250	0.59474	0.43262	0.96269	0.50168	182.69	0.00274
	30	8.071	0.277	0.59476	0.43257	0.96288	0.50335	183.41	0.00275
	40	7.981	0.322	0.59478	0.43248	0.96319	0.50618	184.64	0.00277
	....	7.937	0.344	0.59479	0.43244	0.96335	0.50747	185.24	0.00278
	....	7.921	0.352	0.59480	0.43242	0.96340	0.50810	185.47	0.00278
	....	7.875	0.375	0.59481	0.43238	0.96357	0.50958	186.11	0.00279
	60	7.813	0.406	0.59483	0.43232	0.96380	0.51160	186.99	0.00280
	....	7.687	0.469	0.59487	0.43220	0.96427	0.51577	188.83	0.00283
	80	7.625	0.500	0.59489	0.43213	0.96451	0.51786	189.75	0.00285
	100	7.439	0.593	0.59495	0.43193	0.96525	0.52430	192.62	0.00289
	....	7.375	0.625	0.59497	0.43186	0.96551	0.52657	193.64	0.00290
	120	7.189	0.718	0.59508	0.43165	0.96630	0.53334	196.71	0.00295
	140	7.001	0.812	0.59510	0.43143	0.96714	0.54045	199.98	0.00300
	....	6.875	0.875	0.59515	0.43127	0.96773	0.54538	202.27	0.00303
	160	6.813	0.906	0.59517	0.43119	0.96802	0.54786	203.43	0.00305

PIPE TAPS—(Continued)

Nominal pipe size	Schedule number	Inside Diameter	Wall thickness	$0.5925+\frac{0.0182}{D_1}$	$0.44-\frac{0.06}{D_1}$	$0.935+\frac{0.225}{D_1}$	$\frac{1.43}{\sqrt{D_1}}$	$\frac{875}{D_1}+75$ (B')	$\frac{15\ B'}{10^6}$
10	....	10.374	0.188	0.59425	0.43422	0.95669	0.44398	159.34	0.00239
	....	10.344	0.203	0.59426	0.43420	0.95675	0.44462	159.59	0.00239
	....	10.310	0.219	0.59426	0.43418	0.95682	0.44536	159.87	0.00240
	20	10.250	0.250	0.59428	0.43415	0.95695	0.44666	160.37	0.00240
		10.192	0.279	0.59429	0.43411	0.95708	0.44792	160.85	0.00241
	30	10.136	0.307	0.59430	0.43408	0.95720	0.44916	161.33	0.00242
		10.054	0.348	0.59431	0.43403	0.95738	0.45099	162.03	0.00243
	40	10.020	0.365	0.59432	0.43401	0.95746	0.45175	162.32	0.00243
		9.960	0.395	0.59433	0.43398	0.95759	0.45311	162.85	0.00244
	60	9.750	0.500	0.59437	0.43385	0.95808	0.45797	164.74	0.00247
	....	9.687	0.531	0.59438	0.43381	0.95823	0.45945	165.33	0.00248
	80	9.564	0.593	0.59440	0.43373	0.95852	0.46240	166.49	0.00250
	100	9.314	0.718	0.59445	0.43356	0.95916	0.46856	168.94	0.00253
	....	9.250	0.750	0.59447	0.43351	0.95932	0.47018	169.60	0.00254
	120	9.064	0.843	0.59451	0.43336	0.95982	0.47498	171.54	0.00257
	140	8.750	1.000	0.59458	0.43314	0.96071	0.48343	175.00	0.00262
	....	8.625	1.063	0.59461	0.43304	0.96109	0.48692	176.45	0.00265
	160	8.500	1.125	0.59464	0.43294	0.96147	0.49049	177.94	0.00267
12	....	12.344	0.203	0.59397	0.43514	0.95323	0.40701	145.88	0.00219
	....	12.312	0.219	0.59398	0.43513	0.95328	0.40754	146.07	0.00219
	....	12.274	0.238	0.59398	0.43511	0.95333	0.40817	146.29	0.00219
	20	12.250	0.250	0.59398	0.43510	0.95337	0.40857	146.43	0.00220
		12.192	0.279	0.59399	0.43508	0.95346	0.40954	146.77	0.00220
		12.150	0.300	0.59400	0.43506	0.95352	0.41025	147.02	0.00220
	30	12.090	0.330	0.59400	0.43504	0.95361	0.41127	147.37	0.00221
		12.062	0.344	0.59401	0.43503	0.95365	0.41174	147.54	0.00221
		12.000	0.375	0.59402	0.43500	0.95375	0.41280	147.92	0.00222
	40	11.938	0.406	0.59402	0.43497	0.95385	0.41388	148.30	0.00222
	....	11.874	0.438	0.59403	0.43495	0.95395	0.41499	148.69	0.00223
		11.750	0.500	0.59405	0.43489	0.95415	0.41717	149.47	0.00224
	60	11.626	0.562	0.59406	0.43484	0.95435	0.41939	150.26	0.00225
		11.500	0.625	0.59408	0.43478	0.95456	0.42168	151.09	0.00227
	80	11.376	0.687	0.59410	0.43473	0.95478	0.42398	151.92	0.00228
	100	11.064	0.843	0.59414	0.43458	0.95534	0.42991	154.08	0.00231
	....	11.000	0.875	0.59415	0.43455	0.95545	0.43116	154.54	0.00232
	120	10.750	1.000	0.59419	0.43442	0.95593	0.43614	156.40	0.00235
	140	10.500	1.125	0.59423	0.43429	0.95643	0.44131	158.33	0.00237
	....	10.313	1.219	0.59426	0.43418	0.95682	0.44539	159.84	0.00240
	160	10.126	1.312	0.59430	0.43408	0.95722	0.44938	161.41	0.00242
14	....	13.624	0.188	0.59384	0.43560	0.95152	0.38742	139.22	0.00209
	....	13.560	0.220	0.59384	0.43558	0.95159	0.38833	139.53	0.00209
	....	13.524	0.238	0.59384	0.43556	0.95164	0.38885	139.70	0.00210
	10	13.500	0.250	0.59385	0.43556	0.95167	0.38920	139.82	0.00210
	20	13.375	0.312	0.59386	0.43551	0.95182	0.39101	140.42	0.00211
	30	13.250	0.375	0.59387	0.43547	0.95198	0.39285	141.04	0.00212
		13.188	0.406	0.59388	0.43545	0.95206	0.39377	141.35	0.00212
	40	13.125	0.437	0.59389	0.43543	0.95214	0.39472	141.67	0.00212
		13.062	0.469	0.59390	0.43541	0.95222	0.39657	141.99	0.00213
		13.000	0.500	0.59390	0.43538	0.95231	0.39661	142.31	0.00213
	60	12.814	0.593	0.59392	0.43532	0.95256	0.39948	143.28	0.00215
	....	12.750	0.625	0.59393	0.43529	0.95265	0.40048	143.63	0.00215
		12.688	0.656	0.59393	0.43527	0.95269	0.40136	143.96	0.00216
	80	12.500	0.750	0.59396	0.43520	0.95300	0.40446	145.00	0.00218
	100	12.125	0.937	0.59400	0.43505	0.95356	0.41067	147.16	0.00221
	120	11.876	1.062	0.59403	0.43495	0.95394	0.41495	148.68	0.00223
	140	11.500	1.250	0.59408	0.43478	0.95456	0.42168	151.09	0.00227
	....	11.313	1.344	0.59411	0.43470	0.95489	0.42515	152.34	0.00228
	160	11.188	1.406	0.59413	0.43464	0.95511	0.42752	153.21	0.00230
16	....	15.624	0.188	0.59366	0.43616	0.94940	0.36178	131.00	0.00196
	....	15.524	0.238	0.59367	0.43614	0.94949	0.36294	131.36	0.00197
	10	15.500	0.250	0.59367	0.43613	0.94952	0.36322	131.45	0.00197
	....	15.438	0.281	0.59368	0.43611	0.94957	0.36395	131.68	0.00198
	20	15.375	0.312	0.59368	0.43610	0.94963	0.36469	131.91	0.00198
	....	15.312	0.344	0.59369	0.43608	0.94969	0.36544	132.14	0.00198
	30	15.250	0.375	0.59369	0.43607	0.94975	0.36618	132.38	0.00198
	....	15.188	0.406	0.59370	0.43605	0.94981	0.36693	132.61	0.00199
	....	15.124	0.438	0.59370	0.43603	0.94988	0.36771	132.86	0.00199
	....	15.062	0.469	0.59371	0.43602	0.94994	0.36846	133.09	0.00200
	40	15.000	0.500	0.59371	0.43600	0.95000	0.36922	133.33	0.00200
	....	14.938	0.531	0.59372	0.43598	0.95006	0.36999	133.58	0.00200
	60	14.688	0.656	0.59374	0.43592	0.95032	0.37312	134.57	0.00202
	....	14.625	0.687	0.59374	0.43590	0.95038	0.37393	134.83	0.00202
	....	14.500	0.750	0.59376	0.43586	0.95052	0.37554	135.34	0.00203
	80	14.314	0.843	0.59377	0.43581	0.95072	0.37797	136.13	0.00204
	100	13.988	1.031	0.59380	0.43570	0.95114	0.38303	137.78	0.00207
	120	13.564	1.218	0.59384	0.43558	0.95159	0.38828	139.51	0.00209
	140	13.126	1.437	0.59388	0.43543	0.95214	0.39470	141.66	0.00212
	....	13.000	1.500	0.59390	0.43538	0.95231	0.39661	142.31	0.00213
	160	12.876	1.562	0.59391	0.43534	0.95247	0.39852	142.96	0.00214
18	10	17.500	0.250	0.59354	0.43657	0.94786	0.34184	125.00	0.00188
	20	17.375	0.312	0.59355	0.43655	0.94795	0.34306	125.36	0.00188
	....	17.250	0.375	0.59356	0.43652	0.94804	0.34430	125.72	0.00188
	30	17.125	0.437	0.59356	0.43650	0.94814	0.34556	126.10	0.00189
	....	17.000	0.500	0.59357	0.43647	0.94824	0.34683	126.47	0.00190
	40	16.874	0.563	0.59358	0.43644	0.94833	0.34812	126.86	0.00190
	....	16.813	0.594	0.59358	0.43643	0.94838	0.34875	127.04	0.00190
	....	16.750	0.625	0.59359	0.43642	0.94843	0.34940	127.24	0.00191
	60	16.564	0.718	0.59360	0.43638	0.94858	0.35136	127.82	0.00192
	....	16.500	0.750	0.59360	0.43636	0.94864	0.35204	128.03	0.00192
	....	16.375	0.812	0.59361	0.43634	0.94874	0.35338	128.44	0.00193
	80	16.126	0.937	0.59363	0.43628	0.94895	0.35610	129.26	0.00194
	100	15.688	1.156	0.59366	0.43618	0.94934	0.36104	130.78	0.00196
	120	15.314	1.343	0.59369	0.43608	0.94969	0.36542	132.14	0.00198
	140	14.876	1.562	0.59372	0.43597	0.95012	0.37076	133.82	0.00201
	160	14.625	1.687	0.59374	0.43590	0.95038	0.37393	134.83	0.00202
	160	14.500	1.750	0.59376	0.43586	0.95052	0.37554	135.34	0.00203

PIPE TAPS—(Continued)

Nominal pipe size	Schedule number	Inside Diameter	Wall thickness	$0.5925+\frac{0.0182}{D_1}$	$0.44-\frac{0.06}{D_1}$	$0.935+\frac{0.225}{D_1}$	$\frac{1.43}{\sqrt{D_1}}$	$\frac{875}{D_1}+75$ (B')	$\frac{15\ B'}{10^6}$
20	10	19.500	0.250	0.59343	0.43692	0.94654	0.32383	119.87	0.00180
	....	19.374	0.313	0.59344	0.43690	0.94661	0.32488	120.16	0.00180
	20	19.250	0.375	0.59344	0.43688	0.94669	0.32593	120.45	0.00181
	....	19.124	0.438	0.59345	0.43686	0.94676	0.32700	120.75	0.00181
	30	19.000	0.500	0.59346	0.43684	0.94684	0.32806	121.05	0.00182
	....	18.875	0.562	0.59346	0.43682	0.94692	0.32915	121.36	0.00182
	40	18.814	0.593	0.59347	0.43681	0.94696	0.32968	121.51	0.00182
	....	18.750	0.625	0.59347	0.43680	0.94700	0.33024	121.67	0.00182
	60	18.376	0.812	0.59349	0.43674	0.94724	0.33359	122.62	0.00184
	....	18.250	0.875	0.59350	0.43671	0.94733	0.33474	122.94	0.00184
	....	18.188	0.906	0.59350	0.43670	0.94737	0.33531	123.11	0.00185
	80	17.938	1.031	0.59351	0.43666	0.94754	0.33764	123.78	0.00186
	100	17.500	1.250	0.59354	0.43657	0.94786	0.34184	125.00	0.00188
	....	17.438	1.281	0.59354	0.43656	0.94790	0.34244	125.18	0.00188
	120	17.000	1.500	0.59357	0.43647	0.94824	0.34683	126.47	0.00190
	140	16.500	1.750	0.59360	0.43636	0.94864	0.35204	128.03	0.00192
	....	16.313	1.844	0.59362	0.43632	0.94879	0.35405	128.64	0.00193
	160	16.126	1.937	0.59363	0.43628	0.94895	0.35610	129.26	0.00194
22	....	21.398	0.301	0.59335	0.43720	0.94552	0.30914	115.89	0.00174
	....	21.375	0.312	0.59335	0.43719	0.94553	0.30930	115.94	0.00174
	....	21.320	0.340	0.59335	0.43719	0.94555	0.30970	116.04	0.00174
	....	21.312	0.344	0.59335	0.43718	0.94556	0.30976	116.06	0.00174
	....	21.750	0.375	0.59336	0.43718	0.94559	0.31021	116.18	0.00174
	....	21.200	0.400	0.59336	0.43717	0.94561	0.31058	116.27	0.00174
	....	21.188	0.406	0.59336	0.43717	0.94562	0.31066	116.30	0.00174
	....	21.125	0.438	0.59336	0.43716	0.94565	0.31113	116.42	0.00175
	....	21.062	0.469	0.59336	0.43715	0.94568	0.31159	116.54	0.00175
	....	21.000	0.500	0.59337	0.43714	0 94571	0.31205	116.67	0.00175
	....	20.875	0.562	0.59337	0.43713	0.94578	0.31298	116.92	0.00175
24	10	23.500	0.250	0.59327	0.43745	0.94457	0.29499	112.23	0.00168
	....	23.376	0.312	0.59328	0.43743	0.94462	0.29577	112.43	0.00169
	20	23.250	0.375	0.59328	0.43742	0.94468	0.29657	112.63	0.00169
	....	23.125	0.437	0.59329	0.43741	0.94473	0.29737	112.84	0.00169
	....	23.000	0.500	0.59329	0.43739	0.94478	0.29818	113.04	0.00170
	30	22.876	0.562	0.59330	0.43738	0.94484	0.29898	113.25	0.00170
	....	22.750	0.625	0.59330	0.43736	0.94489	0.29981	113.46	0.00170
	40	22.626	0.687	0.59330	0.43735	0.94494	0.30063	113.67	0.00170
	...	22.500	0.750	0.59331	0.43733	0.94500	0.30147	113.89	0.00171
	60	22.125	0.937	0.59332	0.43729	0.94517	0.30401	114.55	0.00172
	....	21.938	1.031	0.59333	0.43726	0.94526	0.30531	114.88	0.00712
	80	21.564	1.218	0.59334	0.43722	0.94543	0.30794	115.58	0.00173
	100	21.000	1.500	0.59337	0.43714	0.94571	0.31205	116.67	0.00175
	120	20.500	1.750	0.59339	0.43707	0.94598	0.31583	117.68	0.00176
	140	19.876	2.062	0.59342	0.43698	0.94632	0.32075	119.02	0.00178
	....	19.625	2.187	0.59343	0.43694	0.94646	0.32280	119.59	0.00179
	160	19.376	2.312	0.59344	0.43690	0.94661	0.32486	120.16	0.00180

FLANGE TAPS

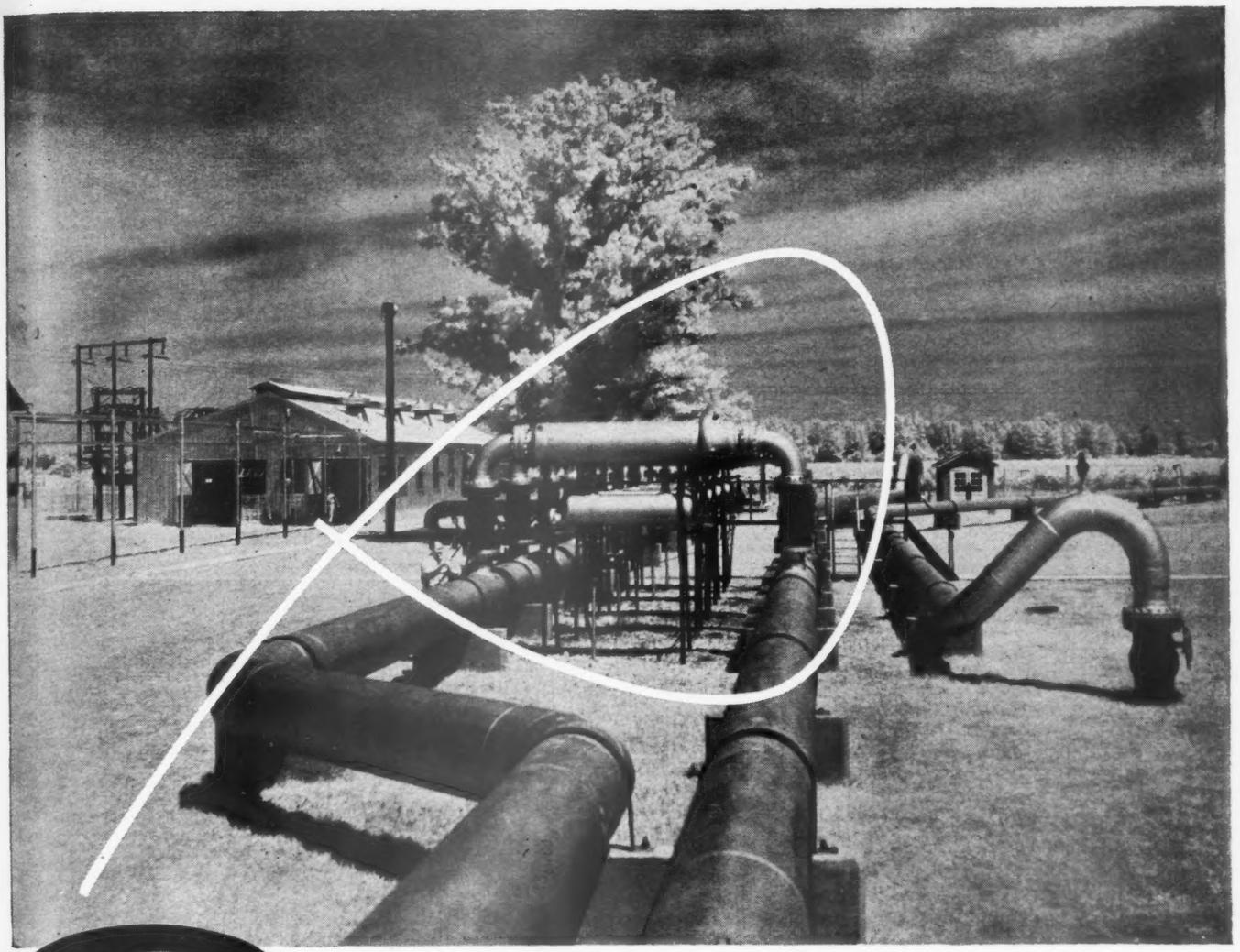
Nominal pipe size	Schedule number	Inside Diameter	Wall thickness	$0.5993+\frac{0.007}{D_1}$	$0.364+\frac{0.076}{\sqrt{D_1}}$	$0.4\left(1.6-\frac{1}{D_1}\right)^5$	$0.07+\frac{0.5}{D_1}$	$0.009+\frac{0.034}{D_1}$	$\frac{65}{D_1^2}+3$	$\frac{530}{\sqrt{D_1}}$ (B)	$\frac{15\ B}{10^6}$
2	40	2.067	0.154	0.60269	0.41686	0.69306	0.31190	0.02545	18.214	368.64	0.00553
	....	2.041	0.167	0.60273	0.41720	0.67402	0.31948	0.02566	18.603	370.98	0.00556
	....	2.000	0.188	0.60280	0.41774	0.64420	0.32000	0.02600	19.250	374.77	0.00562
	80	1.939	0.218	0.60291	0.41858	0.59952	0.32786	0.02653	20.288	380.62	0.00571
	....	1.875	0.250	0.60303	0.41950	0.55242	0.33667	0.02713	21.489	387.06	0.00580
	....	1.750	0.312	0.60330	0.42145	0.46057	0.34571	0.02843	24.224	400.64	0.00601
	160	1.689	0.343	0.60344	0.42248	0.41605	0.36603	0.02913	25.785	407.81	0.00612
	....	1.503	0.436	0.60396	0.42599	0.28532	0.40627	0.03162	31.774	432.31	0.00648
2½	40	2.469	0.203	0.60214	0.41237	0.97476	0.27251	0.02277	13.663	337.30	0.00506
	....	2.441	0.217	0.60217	0.41264	0.95574	0.27483	0.02293	13.909	339.23	0.00509
	80	2.323	0.276	0.60231	0.41386	0.87511	0.28524	0.02364	15.045	347.74	0.00522
	160	2.125	0.375	0.60259	0.41614	0.73502	0.30530	0.02500	17.394	363.58	0.00545
	....	1.771	0.552	0.60325	0.42111	0.47599	0.35232	0.02820	23.724	398.26	0.00597
3	....	3.250	0.125	0.60145	0.40616	1.4417	0.22384	0.01946	9.1538	293.99	0.00441
	....	3.204	0.148	0.60148	0.40646	1.4173	0.22606	0.01961	9.3318	296.09	0.00444
	....	3.124	0.188	0.60154	0.40700	1.3738	0.23005	0.01988	9.6603	299.86	0.00450
	40	3.068	0.216	0.60158	0.40739	1.3430	0.23297	0.02008	9.9056	302.58	0.00454
	....	3.018	0.241	0.60162	0.40775	1.3148	0.23567	0.02026	10.136	305.08	0.00458
	....	2.992	0.254	0.60164	0.40794	1.2998	0.23711	0.02036	10.261	306.40	0.00460
	....	2.922	0.289	0.60170	0.40846	1.2593	0.24112	0.02064	10.130	310.05	0.00465
	80	2.900	0.300	0.60171	0.40863	1.2463	0.24241	0.02072	10.289	311.23	0.00467
	....	2.875	0.312	0.60173	0.40882	1.2315	0.24391	0.02083	10.864	312.58	0.00469
	....	2.687	0.406	0.60190	0.41036	1.1161	0.25608	0.02165	12.003	323.33	0.00485
	160	2.626	0.437	0.60197	0.41090	1.0775	0.26040	0.02195	12.426	327.06	0.00490
	....	2.300	0.600	0.60234	0.41411	0.85914	0.27739	0.02378	15.287	349.47	0.00524
3½	....	3.744	0.128	0.60117	0.40328	1.6828	0.20354	0.01808	7.6370	273.91	0.00411
	....	3.732	0.134	0.60118	0.40334	1.6772	0.20338	0.01811	7.6669	274.35	0.00412
	30	3.704	0.148	0.60119	0.40349	1.6646	0.20499	0.01818	7.7377	275.38	0.00413
	....	3.624	0.188	0.60123	0.40392	1.6280	0.20797	0.01838	7.9492	278.41	0.00418
	40	3.548	0.226	0.60127	0.40435	1.5921	0.21092	0.01858	8.1635	281.37	0.00422
	....	3.438	0.281	0.60134	0.40499	1.5379	0.21544	0.01889	8.4992	285.84	0.00429
	80	3.364	0.318	0.60138	0.40544	1.5006	0.21863	0.01911	8.7438	288.97	0.00433
	....	3.312	0.344	0.60141	0.40576	1.4743	0.22096	0.01926	8.9256	291.23	0.00437
	....	3 062	0.469	0.60159	0.40743	1.3393	0.23329	0.02010	9.9327	302.88	0.00454
	....	2.728	0.636	0.60186	0.41001	1.1418	0.25328	0.02146	11.734	320.89	0.00481

FLANGE TAPS—(Continued)

Nominal pipe size	Schedule number	Inside Diameter	Wall thickness	$0.5993+\frac{0.007}{D_1}$	$0.364+\frac{0.076}{\sqrt{D_1}}$	$0.4\left(1.6-\frac{1}{D_1}\right)^5$	$0.07+\frac{0.5}{D_1}$	$0.009+\frac{0.034}{D_1}$	$\frac{65}{D_1^2}+3$	$\frac{530}{\sqrt{D_1}}$ (B)	$\frac{15\,B}{10^6}$
44	....	4.244	0.128	0.60095	0.40089	1.8913	0.18781	0.01701	6.6088	257.27	0.00386
	....	4.232	0.134	0.60095	0.40094	1.8865	0.18815	0.01703	6.6293	257.63	0.00386
	....	4.216	0.142	0.60096	0.40101	1.8803	0.18860	0.01706	6.6569	258.12	0.00387
	....	4.170	0.165	0.60098	0.40122	1.8624	0.18990	0.01715	6.7380	259.54	0.00389
	....	4.124	0.188	0.60100	0.40142	1.8440	0.19124	0.01724	6.8219	260.98	0.00391
	....	4.090	0.205	0.60101	0.40158	1.8304	0.19225	0.01731	6.8857	262.07	0.00393
	40	4.026	0.237	0.60104	0.40188	1.8043	0.19419	0.01744	7.0102	264.14	0.00396
	....	4.000	0.250	0.60105	0.40200	1.7936	0.19500	0.01750	7.0625	265.00	0.00398
	....	3.958	0.271	0.60107	0.40220	1.7764	0.19633	0.01759	7.1492	266.40	0.00400
	....	3.938	0.281	0.60108	0.40230	1.7678	0.19697	0.01763	7.1914	267.08	0.00401
	....	3.900	0.300	0.60109	0.40248	1.7515	0.19820	0.01772	7.2735	268.38	0.00402
	....	3.876	0.312	0.60111	0.40260	1.7411	0.19900	0.01777	7.3266	269.20	0.00404
	80	3.826	0.337	0.60113	0.40285	1.7192	0.20069	0.01789	7.4404	270.96	0.00406
	....	3.750	0.375	0.60117	0.40325	1.6854	0.20333	0.01807	7.6222	273.69	0.00410
	120	3.626	0.437	0.60123	0.40391	1.6286	0.20789	0.01838	7.9438	278.33	0.00417
	....	3.500	0.500	0.60130	0.40462	1.5687	0.21285	0.01871	8.3061	283.30	0.00425
	160	3.438	0.531	0.60134	0.40499	1.5379	0.21543	0 01889	8.4992	285.84	0.00429
	....	3.152	0.674	0.60152	0.40681	1.3889	0.22863	0.01979	9.5425	298.53	0.00448
5	40	5.047	0.258	0.60069	0.39783	2.1659	0.16907	0.01574	5.5518	235.92	0.00354
	....	4.859	0.352	0.60074	0.39848	2.1071	0.17290	0.01600	5.7531	240.44	0.00361
	80	4.813	0.375	0.60075	0.39864	2.0920	0.17412	0.01608	5.8060	241.58	0.00362
	....	4.688	0.437	0.60079	0.39910	2.0510	0.17665	0.01625	5.9576	244.78	0.00367
	120	4.563	0.500	0.60083	0.39958	2.0077	0.17958	0.01645	6.1218	248.11	0.00372
	160	4.313	0.625	0.60092	0.40060	1.9171	0.18593	0.01688	6.4942	255.20	0.00383
	....	4.063	0.750	0.60102	0.40170	1.8197	0.19306	0.01737	6.9375	262.94	0.00394
6	....	6.287	0.169	0.60041	0.39431	2.4844	0.14953	0.01441	4.6445	211.38	0.00317
	....	6.265	0.180	0.60042	0.39436	2.4801	0.14981	0.01443	4.6560	211.75	0.00318
	....	6.249	0.188	0.60042	0.39440	2.4767	0.15001	0.01444	4.6645	212.02	0.00318
	....	6.187	0.219	0.60043	0.39455	2.4630	0.15081	0.01450	4.6981	213.08	0.00320
	....	6.125	0.250	06.0044	0.39471	2.4484	0.15163	0.01445	4.7326	214.15	0.00321
	....	6.071	0.277	0.60045	0.39484	2.4365	0.15236	0.01460	4.7636	215.10	0.00323
	40	6.065	0.280	0.60045	0.39486	2.4348	0.15244	0.01460	4.7671	215.21	0.00323
	....	5.875	0.375	0.60049	0.39536	2.3902	0.15511	0.01479	4.8832	218.66	0.00328
	80	5.761	0.432	0.60052	0.39566	2.3619	0.15679	0.01490	4.9585	220.81	0.00331
	....	5.625	0.500	0.60054	0.39604	2.3274	0.15889	0.01504	5.0543	223.47	0.00335
	120	5.501	0.562	0.60057	0.39640	2.2948	0.16089	0.01518	5.1480	225.97	0.00339
	160	5.189	0.718	0.60065	0.39736	2.2080	0.16636	0.01555	5.4140	232.67	0.00349
	....	4.897	0.864	0.60073	0.39834	2.1192	0.17210	0.01594	5.7105	239.50	0.00359
8	....	8.309	0.158	0.60014	0.39036	2.8365	0.13018	0.01309	3.9415	183.87	0.00276
	....	8.295	0.165	0.60014	0.39039	2.8346	0.13028	0.01310	3.9447	184.02	0.00276
	....	8.249	0.188	0.60015	0.39046	2.8288	0.13061	0.01312	3.9552	184.53	0.00277
	....	8.219	0.203	0.60015	0.39051	2.8240	0.13083	0.01314	3.9622	184.87	0.00277
	....	8.187	0.219	0.60016	0.39056	2.8202	0.13107	0.01315	3.9698	185.23	0.00278
	....	8.149	0.238	0.60016	0.39062	2.8145	0.13136	0.01317	3.9788	185.66	0.00278
	20	8.125	0.250	0.60016	0.39066	2.8107	0.13154	0.01318	3.9846	185.94	0.00279
	30	8.071	0.277	0.60017	0.39075	2.8002	0.13195	0.01321	3.9978	186.56	0.00280
	40	7.981	0.322	0.60018	0.39090	2.7898	0.13265	0.01326	4.0205	187.61	0.00281
	....	7.937	0.344	0.60018	0.39098	2.7832	0.13300	0.01328	4.0318	188.12	0.00282
	....	7.921	0.352	0.60018	0.39100	2.7813	0.13312	0.01329	4.0360	188.32	0.00282
	....	7.875	0.375	0.60019	0.39108	2.7738	0.13349	0.01332	4.0481	188.86	0.00283
	60	7.813	0.406	0.60020	0.39119	2.7644	0.13400	0.01335	0.0648	189.61	0.00284
	....	7.687	0.469	0.60021	0.39141	2.7447	0.13504	0.01342	4.1000	191.16	0.00287
	80	7.625	0.500	0.60022	0.39152	2.7345	0.13557	0.01346	4.1180	191.94	0.00288
	100	7.439	0.593	0.60024	0.39186	2.7048	0.13721	0.01357	4.1746	194.32	0.00291
	....	7.375	0.625	0.60025	0.39198	2.6938	0.13780	0.01361	4.1951	195.16	0.00293
	120	7.189	0.718	0.60027	0.39234	2.6617	0.13955	0.01373	4.2577	197.67	0.00296
	140	7.001	0.812	0.60030	0.39272	2.6282	0.14142	0.01386	4.3262	200.31	0.00300
	....	6.875	0.875	0.60032	0.39298	2.6042	0.14273	0.01394	4.3752	202.13	0.00303
	160	6.813	0.906	0.60033	0.39312	2.5923	0.14339	0.01399	4.4004	203.05	0.00304
10	....	10.374	0.188	0.59997	0.38760	3.0741	0.11820	0.01228	3.6040	164.55	0.00247
	....	10.344	0.203	0.59998	0.38763	3.0711	0.11834	0.01229	3.6075	164.79	0.00247
	....	10.310	0.219	0.59998	0.38767	3.0680	0.11850	0.01230	3.6115	165.06	0.00248
	20	10.250	0.250	0.59998	0.38774	3.0619	0.11878	0.01232	3.6187	165.54	0.00248
	....	10.192	0.279	0.59999	0.38781	3.0568	0.11906	0.01234	3.6257	166.01	0.00249
	30	10.136	0.307	0.59999	0.38787	3.0507	0.11933	0.01235	3.6327	166.47	0.00250
	....	10.054	0.348	0.60000	0.38797	3.0426	0.11973	0.01238	3.6430	167.15	0.00251
	40	10.020	0.365	0.60000	0.38801	3.0395	0.11990	0.01239	3.6474	167.43	0.00251
	....	9.960	0.395	0.60000	0.38808	3.0334	0.12020	0.01241	3.6552	167.94	0.00252
	60	9.750	0.500	0.60002	0.38834	3.0113	0.12128	0.01249	3.6338	169.74	0.00255
	....	9.687	0.531	0.60002	0.38842	3.0052	0.12162	0.01251	3.6927	170.29	0.00255
	80	9 564	0.593	0.60003	0.38858	2.9912	0.12228	0.01256	3.7106	171.38	0.00257
	100	9.314	0.718	0.60005	0.38890	2.9633	0.12368	0.01265	3.7493	173.66	0.00260
	....	9.250	0.750	0.60006	0.38899	2.9564	0.12405	0.01268	3.7597	174.26	0.00261
	120	9.064	0.843	0.60007	0.38924	2.9010	0.12516	0.01275	3.7912	176.04	0.00264
	140	8.750	1.000	0.60010	0.38969	2.8954	0.12714	0.01289	3.8490	179.17	0.00269
	....	8.625	1.063	0.60011	0.38988	2.8799	0.12797	0.01294	3.8738	180.47	0.00271
	160	8.500	1.125	0.60012	0.39007	2.8634	0.12882	0.01300	3.8996	181.79	0.00273
12	....	12.344	0.203	0.59987	0.38563	3.2348	0.11051	0.01175	3.4266	150.85	0.00226
	....	12.312	0.219	0.59987	0.38566	3.2327	0.11061	0.01176	3.4288	151.04	0.00226
	....	12.274	0.238	0.59987	0.38569	3.2295	0.11074	0.01177	3.4315	151.28	0.00227
	20	12.250	0.250	0.59987	0.38572	3.2284	0.11082	0.01178	3.4332	151.43	0.00227
	....	12.192	0.279	0.59987	0.38577	3.2242	0.11101	0.01179	3.4372	151.79	0.00228
	....	12.150	0.300	0.59988	0.38580	3.2210	0.11115	0.01180	3.4403	152.05	0.00228
	30	12.090	0.330	0.59988	0.38586	3.2168	0.11135	0.01181	3.4447	152.43	0.00229
	....	12.062	0.344	0.59988	0.38588	3.2146	0.11145	0.01182	3.4468	152.60	0.00229
	....	12.000	0.375	0.59988	0.38594	3.2104	0.11167	0.01183	3.4514	153.00	0.00230
	40	11.938	0.406	0.59989	0.38600	3.2051	0.11188	0.01185	3.4561	153.39	0.00230
	....	11.874	0.438	0.59989	0.38606	3.2009	0.11211	0.01186	3.4610	153.81	0.00231
	....	11.750	0.500	0.59990	0.38617	3.1914	0.11255	0.01189	3.4708	154.62	0.00232
	60	11.626	0.562	0.59990	0.38629	3.1819	0.11301	0.01192	3.4809	155.44	0.00233
	....	11.500	0.625	0.59991	0.38641	3.1714	0.11348	0.01196	3.4915	156.29	0.00234
	80	11.376	0.687	0.59992	0.38653	3.1620	0.11395	0.01199	3.5023	157.14	0.00236
	100	11.064	0.843	0.59993	0.38685	3.1360	0.11519	0.01207	3.5310	159.34	0.00239
	....	11.000	0.875	0.59994	0.38692	3.1308	0.11545	0.01209	3.5372	159.80	0.00240
	120	10.750	1.000	0.59995	0.38718	3.1090	0.11651	0.01216	3.5625	161.65	0.00242
	140	10.500	1.125	0.59997	0.38745	3.0864	0.11762	0.01224	3.5896	163.56	0.00245
	....	10.313	1.219	0.59998	0.38767	3.0680	0.11848	0.01230	3.6111	165.04	0.00248
	160	10.126	1.312	0.59999	0.38788	3.0497	0.11938	0.01236	3.6339	166.55	0.00250

FLANGE TAPS—(Continued)

Nominal pipe size	Schedule number	Inside Diameter	Wall thickness	$0.5993+\frac{0.007}{D_1}$	$0.364+\frac{0.076}{\sqrt{D_1}}$	$0.4\left(1.6-\frac{1}{D_1}\right)^5$	$0.07+\frac{0.5}{D_1}$	$0.009+\frac{0.034}{D_1}$	$\frac{65}{D_1^2}+3$	$\frac{530}{\sqrt{D_1}}$ (B)	$\frac{15\,B}{10^6}$
14	....	13.624	0.188	0.59981	0.38459	3.3165	0.10669	0.01150	3.3502	143.59	0.00215
	....	13.560	0.220	0.59982	0.38464	3.3122	0.10687	0.01151	3.3535	143.93	0.00216
	....	13.524	0.238	0.59982	0.38467	3.3111	0.10697	0.01151	3.3554	144.12	0.00216
	10	13.500	0.250	0.59982	0.38468	3.3090	0.10704	0.01152	3.3567	144.25	0.00216
	20	13.375	0.312	0.59982	0.38478	3.3014	0.10738	0.01154	3.3634	144.92	0.00217
	30	13.250	0.375	0.59983	0.38488	3.2938	0.10774	0.01157	3.3702	145.60	0.00218
	....	13.188	0.406	0.59983	0.38489	3.2906	0.10791	0.01158	3.3737	145.94	0.00219
	40	13.125	0.437	0.59983	0.38493	3.2862	0.10810	0.01158	3.3773	146.29	0.00219
	....	13.062	0.469	0.59984	0.38503	3.2819	0.10828	0.01160	3.3810	146.31	0.00219
	....	13.000	0.500	0.59984	0.38508	3.2787	0.10846	0.01162	3.3846	147.00	0.00220
	60	12.814	0.593	0.59985	0.38523	3.2669	0.10902	0.01165	3.3959	148.06	0.00222
	....	12.750	0.625	0.59985	0.38528	3.2626	0.10922	0.01167	3.3999	148.43	0.00223
	....	12.688	0.656	0.59985	0.38533	3.2583	0.10941	0.01168	3.4038	148.76	0.00223
	80	12.500	0.750	0.59986	0.38550	3.2455	0.11000	0.01172	3.4160	149.91	0.00225
	100	12.125	0.937	0.59988	0.38583	3.2789	0.11124	0.01180	3.4421	152.21	0.00228
	120	11.876	1.062	0.59989	0.38705	3.2009	0.11210	0.01186	3.4609	153.79	0.00231
	140	11.500	1.250	0.59991	0.38741	3.1714	0.11348	0.01196	3.4915	156.29	0.00234
	....	11.313	1.344	0.59992	0.38760	3.1568	0.11420	0.01200	3.5078	157.58	0.00236
	160	11.188	1.406	0.59993	0.38772	3.1464	0.11469	0.01204	3.5193	158.45	0.00238
16	....	15.624	0.188	0.59975	0.38323	3.4199	0.10200	0.01118	3.2663	134.08	0.00201
	....	15.524	0.238	0.59975	0.38329	3.4155	0.10221	0.01119	3.2697	134.52	0.00202
	10	15.500	0.250	0.59975	0.38330	3.4144	0.10226	0.01119	3.2706	134.62	0.00202
	....	15.438	0.281	0.59975	0.38334	3.4110	0.10239	0.01120	3.2727	134.89	0.00202
	20	15.375	0.312	0.59976	0.38338	3.4088	0.10252	0.01121	3.2750	135.17	0.00203
	....	15.312	0.344	0.59976	0.38342	3.4055	0.10265	0.01122	3.2772	135.44	0.00203
	30	15.250	0.375	0.59976	0.38346	3.4021	0.10279	0.01123	3.2795	135.72	0.00204
	....	15.188	0.406	0.59976	0.38350	3.3999	0.10292	0.01124	3.2818	136.00	0.00204
	....	15.124	0.438	0.59976	0.38354	3.3966	0.10306	0.01125	3.2842	136.28	0.00204
	....	15.062	0.469	0.59976	0.38358	3.3933	0.10320	0.01126	3.2865	136.56	0.00205
	40	15.000	0.500	0.59977	0.38362	3.3900	0.10333	0.01127	3.2889	136.84	0.00205
	....	14.938	0.531	0.59977	0.38366	3.3878	0.10347	0.01128	3.2913	137.13	0.00206
	60	14.688	0.656	0.59978	0.38383	3.3745	0.10404	0.01131	3.3013	138.29	0.00207
	....	14.625	0.687	0.59978	0.38387	3.3712	0.10419	0.01132	3.3039	138.59	0.00208
	....	14.500	0.750	0.59978	0.38396	3.3646	0.10448	0.01134	3.3092	139.18	0.00209
	80	14.314	0.843	0.59979	.038409	3.3547	0.10493	0.01138	3.3172	140.09	0.00210
	100	13.938	1.031	0.59980	0.38436	3.3340	0.10587	0.01144	3.3346	141.96	0.00213
	120	13.564	1.218	0.59982	0.38464	3.3133	0.10686	0.01151	3.3533	143.91	0.00216
	140	13.126	1.437	0.59983	0.38498	3.2862	0.10809	0.01159	3.3773	146.29	0.00219
	....	13.000	1.500	0.59984	0.38508	3.2787	0.10846	0.01161	3.3846	147.00	0.00220
	160	12.876	1.562	0.59984	0.38518	3.2701	0.10883	0.01164	3.3920	147.70	0.00222
18	10	17.500	0.250	0.59970	0.38217	3.4974	0.09857	0.01094	3.2122	126.69	0.00190
	20	17.375	0.312	0.59970	0.38223	3.4918	0.09878	0.01096	3.2153	127.15	0.00191
	....	17.250	0.375	0.59970	0.38230	3.4872	0.09898	0.01097	3.2184	127.61	0.00191
	30	17.125	0.437	0.59971	0.38236	3.4827	0.09920	0.01098	3.2216	128.07	0.00192
	....	17.000	0.500	0.59971	0.38243	3.4782	0.09941	0.01100	3.2249	128.54	0.00193
	40	16.874	0.563	0.59971	0.38250	3.4726	0.09963	0.01101	3.2283	129.02	0.00194
	....	16.813	0.594	0.59972	0.38253	3.4703	0.09974	0.01102	3.2299	129.26	0.00194
	....	16.750	0.625	0.59972	0.38257	3.4680	0.09985	0.01103	3.2317	129.50	0.00194
	60	16.564	0.718	0.59972	0.38267	3.4602	0.10019	0.01105	3.2369	130.22	0.00195
	....	16.500	0.750	0.59972	0.38271	3.4579	0.10030	0.01106	3.2388	130.48	0.00196
	....	16.375	0.812	0.59973	0.38278	3.4523	0.10053	0.01108	3.2424	131.28	0.00197
	80	16.126	0 937	0.59973	0.38293	3.4422	0.10101	0.01111	3.2500	131.98	0.00198
	100	15.688	1.156	0.59974	0.38319	3.4233	0.10187	0.01117	3.2641	133.81	0.00201
	120	15.314	1.343	0.59976	0.38342	3.4055	0.10265	0.01122	3.2772	135.75	0.00204
	140	14.876	1.562	0.59977	0.38370	3.3844	0.10361	0.01128	3.2937	137.41	0.00206
	....	14.625	1.687	0.59978	0.38387	3.3712	0.10427	0.01132	3.3039	138.59	0.00208
	160	14.500	1.750	0.59978	0.38396	3.3646	0.10448	0.01134	3.3092	139.18	0.00209
20	10	19.500	0.250	0.59966	0.38121	3.5637	0.09564	0.01074	3.1709	120.02	0.00180
	....	19.374	0.313	0.59966	0.38127	3.5602	0.09581	0.01075	3.1732	120.41	0.00181
	20	19.250	0.375	0.59966	0.38132	3.5556	0.09597	0.01077	3.1754	120.80	0.00181
	....	19.124	0.438	0.59967	0.38138	3.5522	0.09614	0.01078	3.1777	121.20	0.00182
	30	19.000	0.500	0.59967	0.38144	3.5487	0.09632	0.01079	3.1801	121.59	0.00182
	....	18.875	0.562	0.59967	0.38149	3.5441	0.09649	0.01080	3.1824	121.99	0.00183
	40	18.814	0.593	0.59967	0.38152	3.5418	0.09658	0.01081	3.1837	122.19	0.00183
	....	18.750	0.625	0.59967	0.38155	3.5407	0.09667	0.01081	3.1849	122.40	0.00184
	60	18.376	0.812	0.59968	0.38173	3.5281	0.09721	0.01085	3.1925	123.64	0.00185
	....	18.250	0.875	0.59968	0.38179	3.5236	0.09740	0.01086	3.1952	124.06	0.00186
	....	18.188	0.906	0.59968	0.38182	3.5213	0.09749	0.01087	3.1965	124.27	0.00186
	80	17.938	1.031	0.59969	0.38194	3.5122	0.09787	0.01090	3.2020	125.14	0.00188
	100	17.500	1.250	0.59970	0.38217	3.4974	0.09857	0.01094	3.2122	126.69	0.00190
	....	17.438	1.281	0.59970	0.38220	3.4940	0.09867	0.01095	3.2138	126.92	0.00190
	120	17.000	1.500	0.59971	0.38243	3.4782	0.09941	0.01100	3.2249	128.54	0.00193
	140	16.500	1.750	0.59972	0.38271	3.4579	0.10030	0.01106	3.2388	130.48	0.00196
	....	16.313	1.844	0.59973	0.38282	3.4501	0.10065	0.01108	3.2443	131.22	0.00197
	160	16.126	1.937	0.59973	0.38293	3.4422	0.10101	0.01111	3.2500	131.98	0.00198
22	....	21.398	0.301	0.59963	0.38043	3.6169	0.09337	0.01059	3.1420	114.57	0.00172
	....	21.375	0.312	0.59963	0.38044	3.6157	0.09339	0.01059	3.1423	114.63	0.00172
	....	21.320	0.340	0 59963	0.38046	3.6146	0.09345	0.01059	3 1430	114.78	0.00172
	....	21.312	0.344	0.59963	0.38046	3.6146	0.09346	0.01060	3.1431	114.80	0.00172
	....	21.250	0.375	0.59963	0.38049	3.6122	0.09353	0.01060	3.1439	114.97	0.00172
	....	21.200	0 400	0.59963	0.38051	3.6111	0.09358	0.01060	3.1446	115.11	0.00173
	....	21.188	0.406	0.59963	0.38051	3.6111	0.09360	0.01060	3.1448	115.14	0.00173
	....	21 125	0.438	0.59963	0.38054	3.6099	0.09367	0.01061	3.1456	115.31	0.00173
	....	21.062	0.469	0.59963	0.38056	3.6076	0.09374	0.01061	3.1465	115.48	0.00173
	....	21.000	0.500	0.59963	0.38058	3.6064	0.09381	0.01062	3.1474	115.66	0.00173
	....	20.875	0.562	0.59964	0.38063	3.6030	0.09395	0.01063	3.1492	116.00	0.00174
24	10	23.500	0.250	0.59960	0.37968	3.6649	0.09128	0.01045	3.1177	109.33	0.00164
	....	23.376	0.312	0.59960	0.37972	3.6625	0.09139	0.01045	3.1190	109.62	0.00164
	20	23.250	0.375	0.59960	0.37976	3.6602	0.09150	0.01046	3.1202	109.92	0.00165
	....	23.125	0.437	0.59960	0.37980	3.6578	0.09162	0.01047	3.1216	110.21	0.00165
	....	23.000	0.500	0.59960	0.37985	3.6543	0.09174	0.01048	3.1229	110.51	0.00166
	30	22.876	0 562	0.59961	0.37989	3.6508	0.09186	0.01049	3.1242	110.81	0.00166
	....	22 750	0 625	0.59961	0.37993	3.6484	0.09198	0.01049	3.1256	111.12	0.00167
	40	22.626	0.687	0.59961	0.37998	3.6461	0.09210	0.01050	3.1270	111.42	0.00167
	....	22.500	0.750	0.59961	0.38002	3.6438	0.09222	0.01051	3.1284	111.73	0.00168
	60	22.125	0.937	0.59962	0.38016	3.6344	0.09260	0.01054	3.1328	112.68	0.00169
	....	21.938	1.031	0.59962	0.38023	3.6297	0.09279	0.01055	3.1350	113.16	0.00170
	80	21.564	1.218	0.59962	0.38037	3.6204	0.09319	0.01058	3.1398	114.13	0.00171
	100	21.000	1.500	0.59963	0.38058	3.6111	0.09331	0.01062	3.1474	115.66	0.00173
	120	20.500	1.750	0.59964	0.38078	3.5925	0.09439	0.01066	3.1547	117.06	0.00176
	140	19.876	2.062	0.59965	0.38105	3.5752	0.09516	0.01071	3.1645	118.88	0.00178
	....	19.625	2.187	0.59966	0.38116	3.5671	0.09548	0.01073	3.1688	119.64	0.00179
	160	19.376	2.312	0.59966	0.38126	3.5602	0.09580	0.01075	3.1731	120.40	0.00181



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THE AEROTEC CORPORATION
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determination of K_e are as follows:

1. For flange taps:

$$K_e = 0.5993 + \frac{0.007}{D_1} + \left(0.364 + \frac{0.076}{\sqrt{D_1}}\right)\beta^4 + 0.4\left(1.6 - \frac{1}{D_1}\right)^5 \left[\left(0.07 + \frac{0.5}{D_1}\right) - \beta\right]^{5/2} - \left(0.009 + \frac{0.034}{D_1}\right)\left((0.5 - \beta)^{3/2} + \left(\frac{65}{D_1^2} + 3\right)(\beta - 0.7)^{5/2}\right)$$

2. For pipe taps:

$$K_e = 0.5925 + \frac{0.0182}{D_1} + \left(0.44 - \frac{0.06}{D_1}\right)\beta^2 + \left(0.935 + \frac{0.225}{D_1}\right)\beta^5 + 1.35\beta^{14} + \frac{1.43}{\sqrt{D_1}}(0.25 - \beta)^{5/2}$$

Where:

K_e = coefficient of discharge when the Reynolds number is equal to 00.000015D

β = ratio of orifice diameter to upstream pipe diameter D_2/D_1

The Author

J. W. J. Bercher resigned from Tide Water Associated Oil Company in 1948 after 10 years in gas cycling and natural gasoline plants, to accept the position of engineering inspector with Texas Eastern Transmission Corporation. He became assistant division manager of Division III of Texas Eastern in May of last year.

D_2 = diameter of the orifice

D_1 = diameter of pipe at the upstream pressure connection.

After K_e is determined, K_o may be found from the relation:

3. $$K_o = \frac{K_e}{1 + \frac{15E}{10^6 \times D_2}}$$

Where:

4. $E = D_2\ (830 - 5000\beta + 9000\beta^2 - 4200\beta^3 + B)$

5. $B = \frac{530}{\sqrt{D_1}}$, for flange taps

6. $B = \frac{875}{D_1} + 75$, for pipe taps

The solution of 4 above may be eliminated from the calculations as shown below:

Since:

$$K_o = \frac{K_e}{1 + \frac{15E}{10^6 \times D_2}}$$

And since:

$E = D_2\ (830 - 5000\beta + 9000\beta^2 - 4200\beta^3 + B)$

Then if:

$J = (830 - 5000\beta + 9000\beta^2 - 4200\beta^3)$

$E = D_2\ (J + B)$

Substituting in 3:

$$K_o = \frac{K_e}{1 + \frac{15D_2\ (J + B)}{10^6 \times D_2}} = \frac{K_e}{1 + 0.000015J + 0.000015B}$$

* * *

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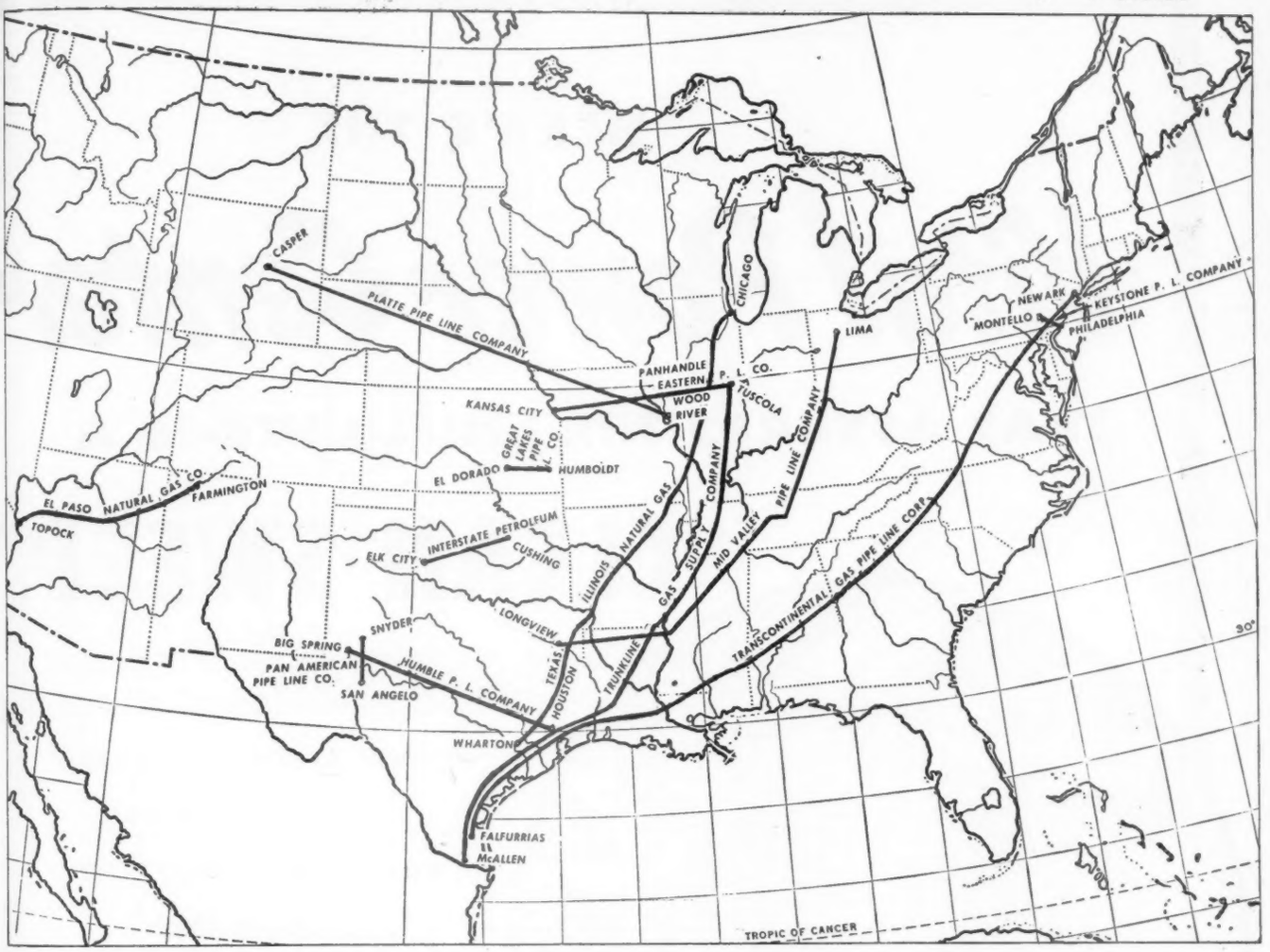

Map shows microwave systems installed or being installed by pipe line companies.

Microwave Communications Systems

Factors to be considered in installing this newest of pipe line communication methods

W. T. BULLA

SOME 12 or more major pipe line companies already have, or are now installing, microwave communication systems.

Communication, remote operation, and telemetering requirements of several of the long haul pipe lines constructed, or under construction in 1950 and 1951, are to be provided through the unique method used in microwave.

The ready acceptance of this development in the art of communication indicates the great need for an improved system of communication, such as this new technique developed since World War II.

The tremendous volume of volatile oils and natural gas being transported daily from the producing areas to the large centers, for use in essential industry and the heating of homes, are so depended upon by the American people that the pipe line company must and does adopt every improved tool to insure the function of its lines in delivering its particular commodity regularly each day of the year.

It is most desirable that the communication system be as positive and reliable as possible, therefore it is felt that the adoption of a microwave sys-

EXCLUSIVE

The Author

W. T. Bulla has engaged in communication work for the last 25 years with oil and gas companies. He has been active in radio matters for a number of years representing the American Gas Association. He is presently employed by Natural Gas Pipeline Company of America as assistant superintendent of operations, with headquarters in Chicago, Illinois.

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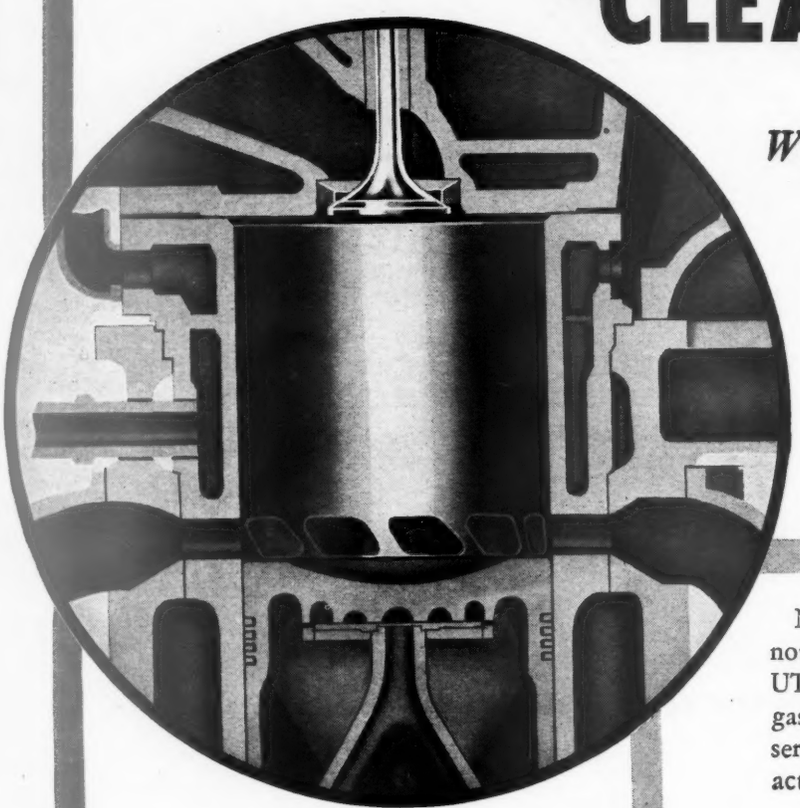

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ESSENTIAL FEATURES

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- uniform cylinder temperature results in equal wall stress eliminating harmful stresses.

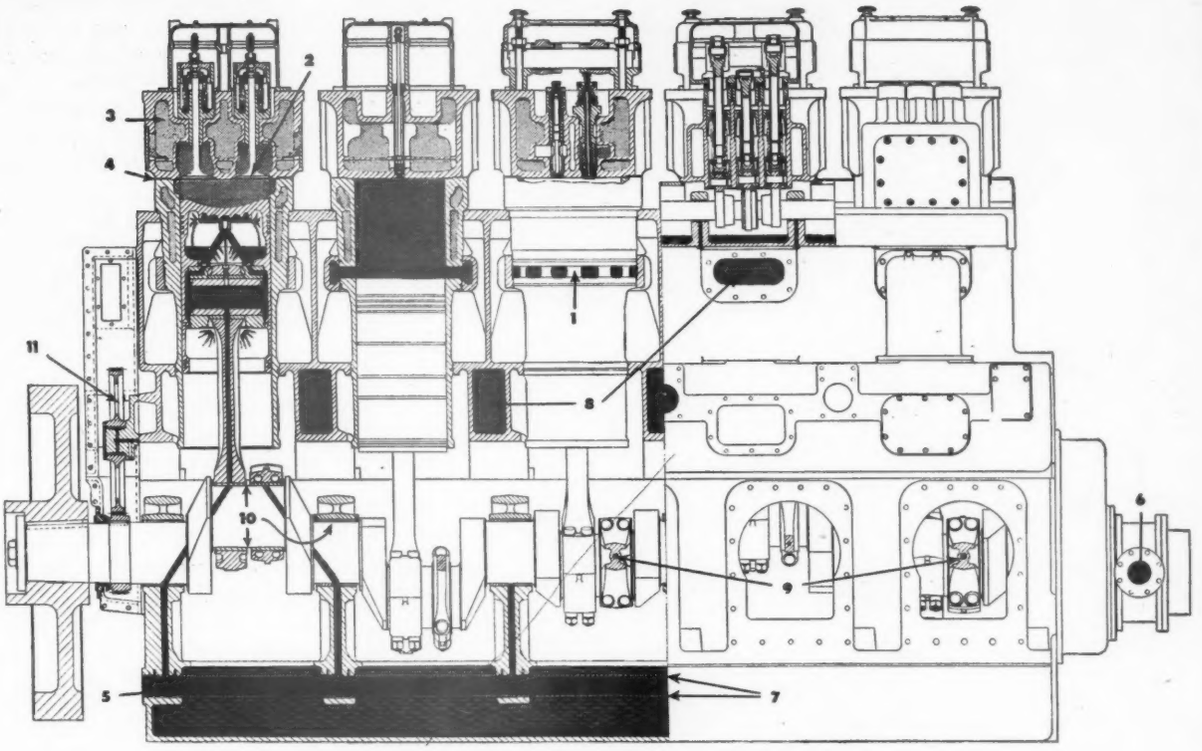
RESULTS: less down-time . . . lower-cost maintenance . . . higher efficiency.

Nothing in recent years has attracted as much notice as the quick success of Worthington's uniflo UTC-16. For, here is peak economy and efficiency in gas transmission and many petroleum processing services — proved by exhaustive testing under actual working conditions.

Uniflo Scavenging . . . A Truly Great Improvement

A major factor in the UTC-16's outstanding performance is the Worthington uniflo scavenging principle. Concentrated in the *Vital Power Center* — see illustration — the uniflo method assures a thorough-going "clean sweep" resulting in many bene-

WORTHINGTON



Advanced Features Of The UTC-16

1 360° inlet ports with directional flow.

2 Large exhaust valves. Cam-operated — positive timing — extra large exhaust passages.

3 Cylinder head cooling. Large passages — water carefully directed for uniform cooling.

4 Metal-to-metal joints. Cylinder heads seat on liners — no gaskets.

5 Positive lubrication. Entire running gear pressure lubricated.

6 Lube oil pump. Low speed direct connected . . . readily accessible.

7 Cast-in lubricating oil manifolds. Jointless — no internal connections — large sump.

8 Large scavenging air supply. Multiple air pumps — reciprocating type two scavenging reservoirs one on each side of engine — large elbows from reservoirs to ports.

9 Well-spaced compressor cylinders. Complete accessibility of cylinders and crossheads — permits use of large cylinders.

10 Large bearing area. Low unit pressure . . . cool running . . . long life . . . four studded bearing caps . . . precision-type bearing shells.

11 Gear driven camshaft. Positive, quiet operation.

fits for smoother operation. It is the first time this type of scavenging has been adapted to engine compressor duty and its incorporation with the advanced over-all UTC-16 design marks the beginning of a new era in lower-cost, more dependable performance.

Versatility

While designed primarily as a pipeline gas engine compressor, the UTC-16 is suitable for many other services, including: pressure maintenance on oil wells . . . in natural gasoline plants . . . in oil refineries, for solvent extraction, vapor recovery, recycling and stabilization of gases . . . in petrochemical processing of products made from natural gas under pressure . . . in many refrigeration applications.

The uniflo UTC-16 is built in sizes ranging from 800 to 2,000 hp. If you have a process where gas must be compressed, and a suitable gas fuel is available, make a point of investigating this outstanding angle gas engine compressor. For further proof that *there's more worth in Worthington*, contact our nearest Branch Office, or write the *Worthington Pump and Machinery Corporation, Engine Sales Div., Buffalo, N. Y.*

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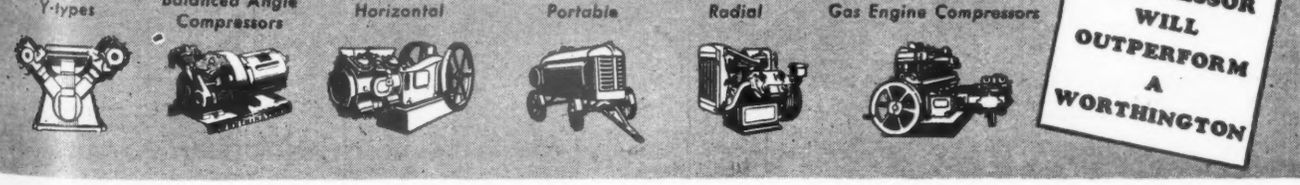
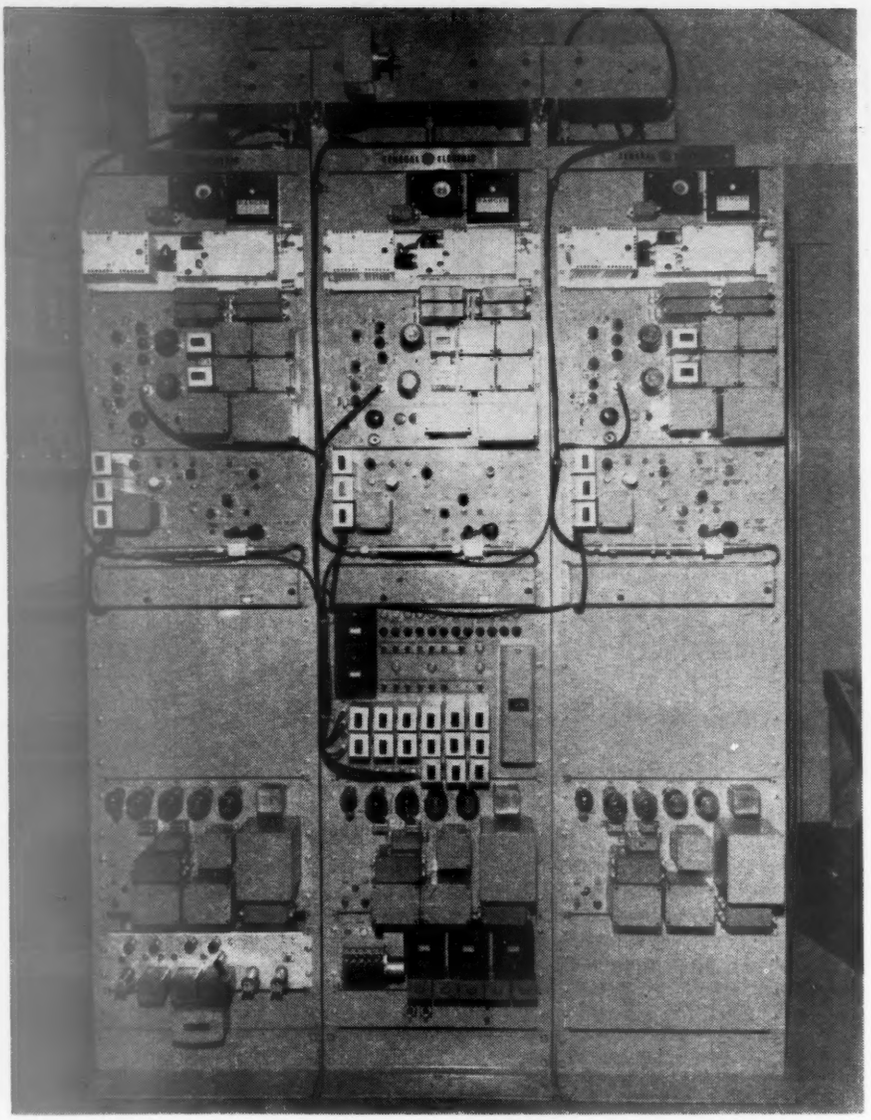


NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON



A typical assembly for a repeater station.

tem, and the installation of it, must be approached carefully.

The fact that such a large number of pipe line companies are adopting microwave as a principal means of communication, and many of them over long distances, indicates the approval given this means of communication.

After deciding upon the use of a private microwave system, one of the first steps is to select the route of the system, which must be closely parallel to the route of the pipe line, at the same time allowing for the selection of high ground for the location of repeater stations.

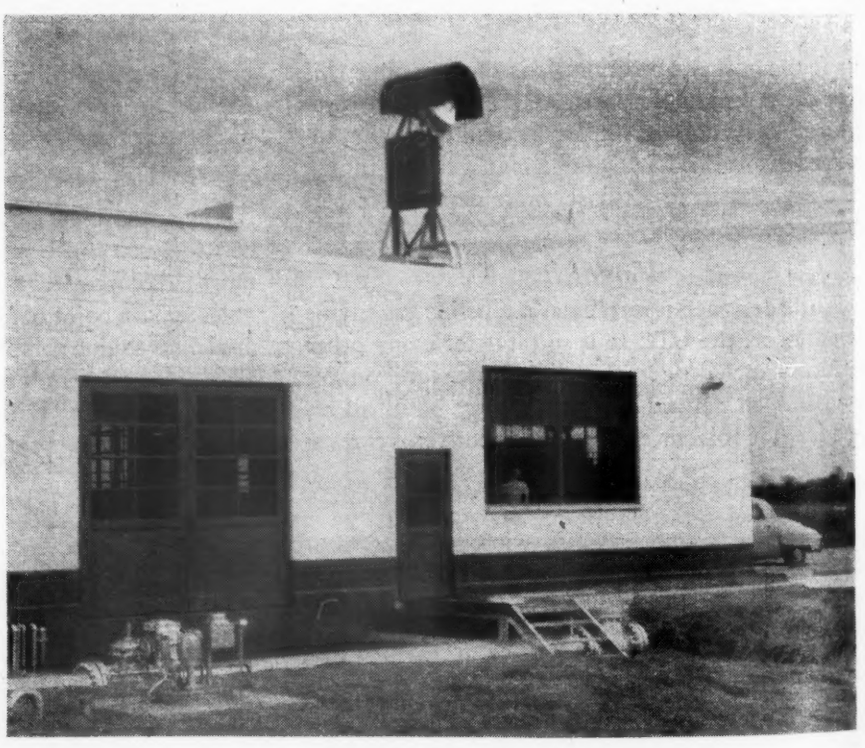
The selection of repeater station locations and determination of tower heights should be a joint venture of representatives of the microwave manufacturer and the pipe line company. Their efforts will have a great effect on the entire system from the standpoint of propagation and cost.

The narrow microwave beam is projected from one repeater station to another, in straight lines, just as visible light moves, therefore, the survey crew must set up theoretical paths to be utilized if the beam can be kept clear from all obstacles such as higher ground, trees, etc. This can be done to some extent by the selection of locations or high terrain and the utilization of the highest tower permissible within the limits of satisfactory rigidity, and of course the cost of the site towers and equipment must be considered, as well as the cost of providing electric power.

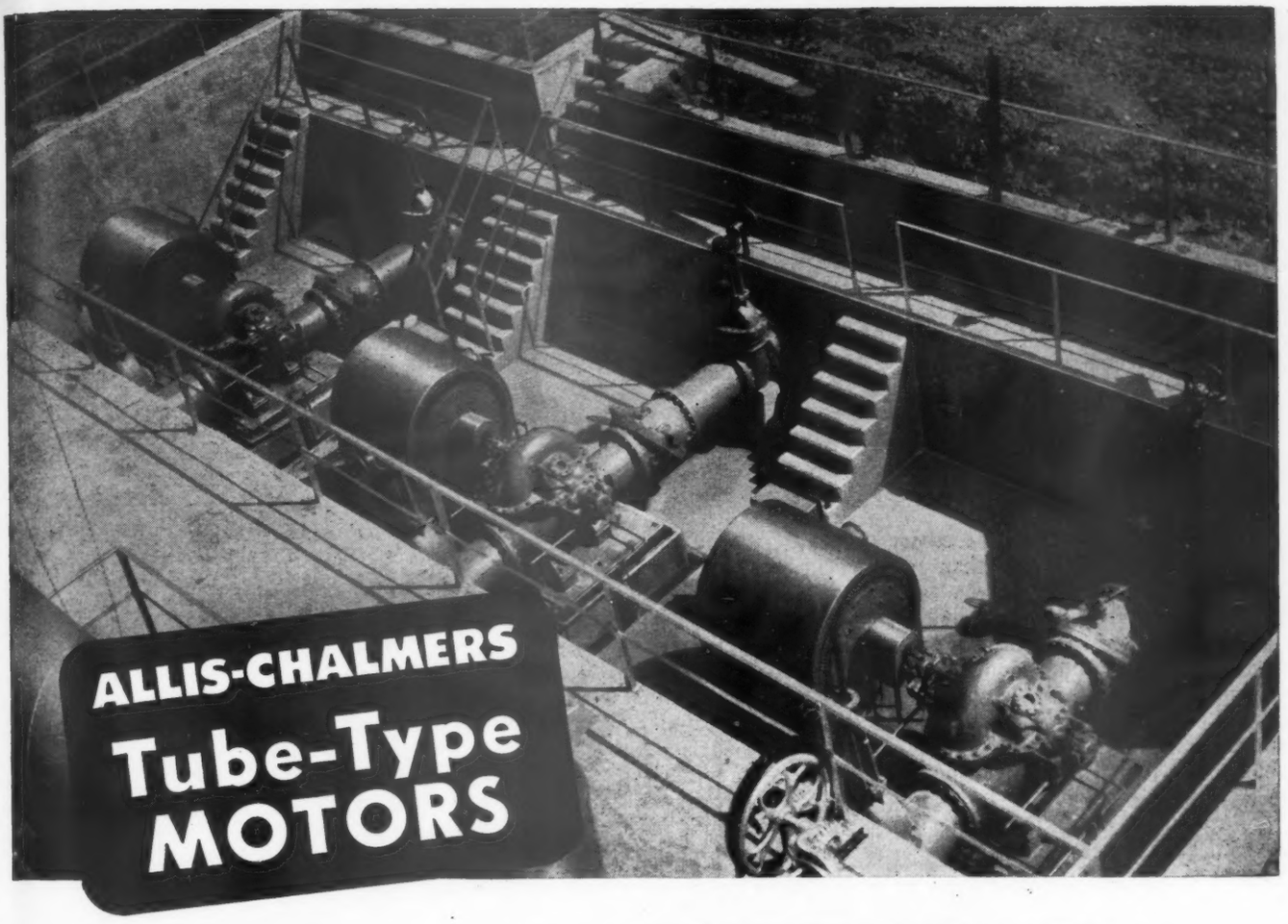
This means that the repeater stations will occur every 15 to 30 miles, although if exceptionally high ground is available, locations might be as distant as 50 to 100 miles.

Inasmuch as these repeater stations are unattended and usually at remote locations, every consideration must be given to an installation that will afford reasonable protection to the service. In this respect the utilization of masonry block buildings lend themselves quite well to such locations, and certain types of fencing may also be desirable as further protection.

A high degree of reliability and continuity of service can be provided by automatic switching of standby RF equipment on the failure of any of the radio frequency apparatus. It



Microwave station operating as a spur off a main repeater six miles away.



DIRT and CORROSION Can't Harm These Motors

OUTDOOR OPERATION in the corrosive atmosphere of a Mexican oil refinery does not affect the operation of these three Allis-Chalmers 450 hp tube-type totally-enclosed, fan-cooled motors driving Allis-Chalmers centrifugal pumps. Cleaning is practically eliminated, but can be done quickly and easily if required.

How Tube Cooling Works

In this motor design, a nest of tubes surrounds the stator. (You can see the ends of the tubes in the picture.) The air inside the motor is circulated around these tubes by fans, transferring internal heat to the tubes. A powerful fan blows outside air through the tubes carrying away the heat. Tubes are straight and smooth. There are no pockets or crevices where dirt can collect. If oily dirt should stick to the tubes, it can be removed with a long-handled brush without stopping the motor.

Because of this highly efficient cooling system, tube-type totally-enclosed, fan-cooled machines can be built in much larger sizes than conventional TEFC machines. Explosion-proof motors of similar design are built in the same ratings.

Ideal for outdoor operation, tube-type TEFC motors are also widely used for indoor installations subject to adverse ambient conditions.

Unit Responsibility

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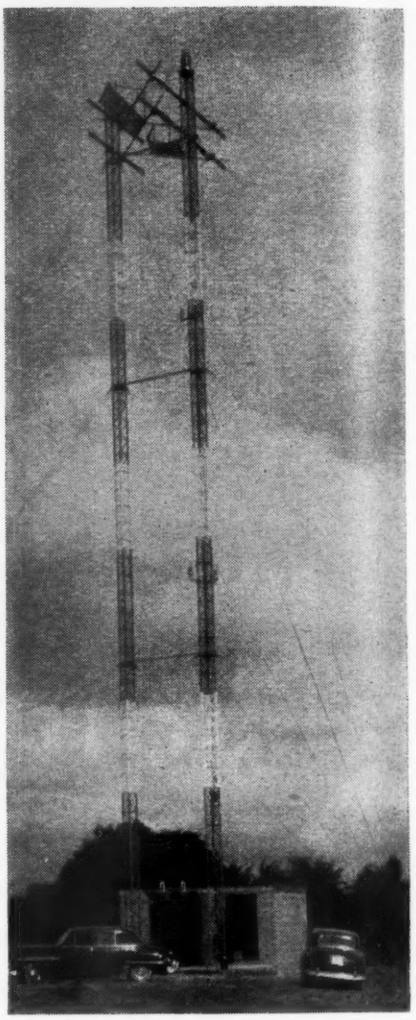
ALLIS-CHALMERS

Equipment house and grounds of an isolated repeater station.

Twin towers showing passive reflector at top and concrete building of microwave repeater station.



is felt that this protection is necessary in any system where more than two voice channels are in service and where no alternative route is provided.

Furthermore, as electric power is necessary in the operation of this equipment, it is advisable to install a small power plant, probably to operate on gasoline, which is usually available, and which can be transported readily.

The two standby units recommended provide that in event of a failure of the equipment or power supply, the automatic switching panels will pick up the standby units and disconnect the units or sources that have failed.

These failures may readily be transmitted to certain maintenance headquarters automatically through the fault location units in order that maintenance men may follow up to correct the difficulty.

Microwave systems are available in any number of voice channels up to 24, although most of the systems now being installed have an average of 5 activated channels.

In addition to the service derived from the microwave channels, many of the pipe line companies will tie-in VHF radio to provide a connection for voice communication from point-to-point and to mobile units in company cars and planes. * * *

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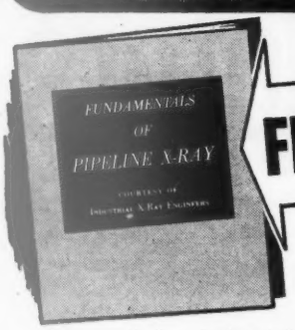

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Some microwave system specifications

Manufacturer's name, address, and equipment model number and/or name	Frequency Range (MC)	Transmitted R-F band width MC	Type Modulation	Number of channels
Federal Telephone and Radio Corporation 100 Kingsland Road, Clifton, N. J.	1700–2200	5.6	PTM	1 to 23
General Electric Company Electronics Park, Syracuse, N. Y.	1850–1990	6	PWM	1 to 24
Motorola, Inc. 4545 Augusta Blvd., Chicago 51, Ill.	6125–7425	10	FM-3	1 to 24 VC
Philco Corporation Tioga & C Streets, Phila. 34, Pa.	5925–7425	10	FM-6	1 — 32 VC
Radio Corp. of America Front & Cooper Sts., Camden 2, N. J.	1850–2200	5	FM	1 to 24

FM—Frequency modulation PTM—Pulse time Modulation PWM—Pulse width modulation

Microwave systems under construction or in service of pipe line companies

Name	Route of microwave system	Frequencies (MC)	Maximum channels possible	Channels to be activated	Approximate length in miles
Transcontinental Gas Pipe Line Corp.	Falfurrias, Texas to Newark, N. J.	1855–1905	12	8	1800
Pan American Pipe Line Company	Snyder to San Angelo, Texas	6705–6805	10	6	100
El Paso Natural Gas Company	Topock, Ariz. to Farmington, N. M.	5925–7425	23	3	420
Great Lake Pipe Line Company	Eldorado to Humbolt, Kansas	6580–6820	10	1	115
Panhandle Eastern Pipe Line Co.	Kansas City, Mo. to Tuscala, Ill.	6625–6805	10	5	330
Trunkline Gas Supply Company	McAllen, Tex. to Bourbon, Ill.	1880–1980	23	8	1000
Interstate Petroleum Comm., Inc.	Elk City to Cushing, Oklahoma	6705–6805	10	2	150
Texas Illinois Natural Gas Pipe Line Co.	Chicago, Ill. to Houston, Tex.	6625–6805	10	8	1200
Keystone Pipe Line Company	Philadelphia to Montello, Pa.	1855–1905	23	2	150
Humble Pipe Line Company	Houston to Big Springs, Tex.	5900–7000	24	8	400
Mid-Valley Pipeline Co.	Longview, Tex. to Lima, Ohio	6625–6805	10	6	1000
Platte Pipe Line Company	Casper, Wyo. to Wood River, Ill.	5925–7425	24	5	1000

Remarks: The information shown above is thought to be reliable, but not guaranteed. In addition to the above there are a number of systems in the planning stage.

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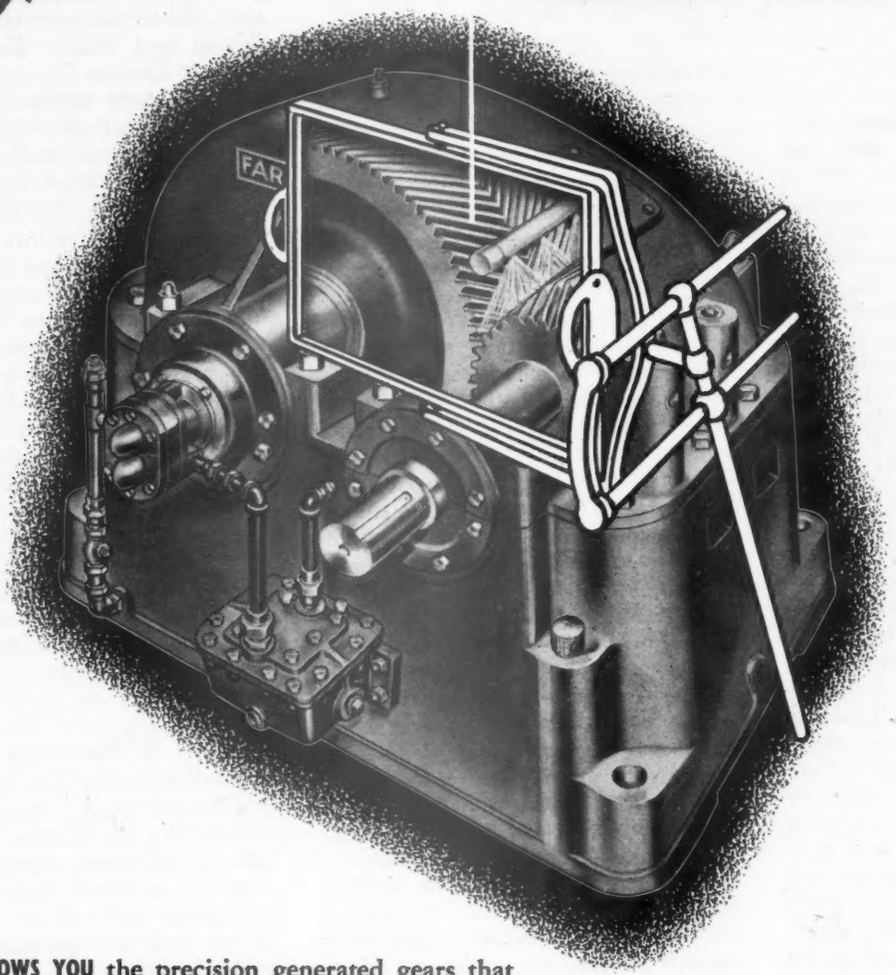

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IT DOES NOT SHOW YOU the knowledge which has been accumulated by Farrel engineers in the making of thousands of gear units for oil field, industrial and marine service . . . the data obtained from customer service reports . . . or the extensive tests conducted by the company's research department—all of which have contributed to the reputation these units have for providing long, *trouble-free performance with minimum maintenance.*

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U. S. Tanker Fleet Prospects

Decline of fleet unlikely through 1951-52; but long-range prospects of tankers engaged in foreign trades do not appear very bright

THE Korean War has arrested, probably only temporarily, a slow but steady decline that began in 1949 in the huge postwar tanker fleet operated under the U. S. flag. The active U. S. tanker fleet actually increased from September 30 to December 31, 1950, as 12 vessels of 168,000 deadweight tons, which had been laid up, were returned to service. How long the present strong worldwide demand for tankers will continue is uncertain, but probabilities are that it will prevent any further decline in the U. S. fleet as a whole, at least through 1951 and possibly 1952.

For the long pull, however, the 38.6 per cent of the U. S. tanker fleet engaged in foreign trade faces problems that appear almost certain to force a further decline. The most serious of these, of course, is the higher operatting costs of tankers under the U. S. flag. This competitive disadvantage of the U. S. tanker operator will be aggravated in the next few years by three other factors: (1) The changing pattern of oil production and consumption and its effect on tanker employment, (2) the tremendous postwar tanker building program which is still going on and increasing the world tanker fleet at a substantial rate, and (3) the building of pipe lines in the Middle East, which is reducing employment opportunities for tankers.

Despite these problems, the prediction of the Association of American Ship Owners, made in the *Shipping Survey* published in November, 1948, that the U. S. flag tanker fleet would level off eventually at close to 6,000,000 deadweight tons still appears to be sound. The domestic tanker fleet alone now totals more than the 4,000,000 deadweight tons predicted as normal. The desirability of large operators maintaining considerable flexibility in their fleets as between foreign trade and the protected domestic services alone would dictate the maintenance of a fairly sizable fleet of American flag tankers in the foreign trades despite the competitive disadvantages.

Transportation Pattern

The pattern of worldwide transportation of petroleum and its products by seagoing tanker breaks up into four major movements. These are:

1. U. S. coastwise movements from the Gulf to the Atlantic seaboard and along the Pacific coast. The first is by far the most important, using nearly seven-eighths of the tankers in the domestic trades. Only a handful of tankers haul oil in the intercoastal trades and to Hawaii, Puerto Rico and Alaska. This is the only movement in which U. S. flag tankers have an assured demand, as foreign flag operators are excluded from the domestic trade by law. This domestic movement is increasing, but at a moderate rate.

2. Movement of exports of both crude and refined products from the U. S. This movement, which was fairly substantial prior to World War II, is decreasing now at a fairly rapid rate and promises to decline still further. That is because the U. S., which had been a net exporter of petroleum and its products throughout its history except for a brief period in the 1920's, shifted and became a net importer in 1948, with the excess of imports over exports increasing each year since then. This shift is due primarily to the fact that both proved reserves and production in the great Middle East fields are increasing much more rapidly than in the Western Hemisphere, while U. S. consumption continues to increase at a tremendous rate.

3. Movements from the Caribbean producing areas to the United States and to other consuming areas, chiefly Europe. This movement has been fairly static for the last few years and promises to remain so.

4. Movements from the Middle East producing areas to the major consumption centers, chiefly Europe at present. This movement is increasing rapidly both in absolute volume and in relative importance in the worldwide pattern as production from the fabulous Middle East fields is stepped up.

It is in the decline of movement (2) that the American flag tanker fleet engaged in foreign trade has suffered most in the last two years. On December 31, 1948, the U. S. had nearly 3,000,000 deadweight tons of tankers engaged in the foreign trades. Of these, approximately 1,000,000 tons was in the nearby foreign trades, consisting almost entirely of movements from the Caribbean to the U. S. Another 1,100,000 tons were engaged in trading entirely between foreign countries, chiefly movements from the Caribbean and Middle East producing areas to Europe. The remaining 900,000 tons were engaged in the U. S. foreign trade, consisting mainly of exports of products to Europe and imports of crude from the Middle East.

By December 31, 1950, U. S. flag tankers engaged in foreign trade had shrunk to slightly less than 2,500,000 tons. We still had nearly 1,000,000 tons in the foreign to foreign trades, a drop of 120,000 tons. Tonnage in the nearby foreign trades had increased 20 per cent to 1,200,000 tons, largely because of our increased imports of crude from the Caribbean. But there were only 327,000 tons of tankers engaged in the foreign trade of the U. S. as compared to 900,000 tons two years before. The change was due mainly to the decline in U. S. exports (Europe is depending more on the Middle East), but also in part to the building up of foreign flag tanker fleets.

U. S. Operating Costs

Tankers under the American flag can compete in the foreign trades and still make a profit in the present market where demand exceeds supply and rates are extremely high. If and when conditions settle down to something like normal, the American tanker operator will be at a severe disadvantage in the foreign trades, due to higher operating costs under the American flag. The biggest item is wages, which are twice as much as those of the average foreign flag operator. Subsistence, supplies, and repairs all cost the American operator more than they do his foreign flag competitor.

For the average T2 tankers, operation under the American flag costs about $15,000 a month more than under the average foreign flag. Put another way, this means that it costs the foreign flag operator about 25 per cent less to deliver a ton of oil cargo than it does the American flag tanker. With that kind of cost differential against him, it is easy to forecast what will happen to the independent American flag tanker trying to compete in the foreign trades once the world tanker fleet is built up to the

point where supply and demand are in balance and tanker rates become truly competitive. A moderate decline in the U. S. flag tanker fleet in foreign trade appears inevitable sooner or later.

U. S. Exports, Imports

Table 1 shows U. S. exports and imports of oil for 1939 and for each year from 1945 through 1950. It shows dramatically what has happened since 1947 and the decline in U. S. exports that still continues. Where we had a net export balance of 355,000 bbl per day in 1939, in 1950 this had shifted to a net import balance of 556,000 bbl daily. In a little over 10 years, we switched from exporting 130,000,000 bbl net to importing 203,000,000 bbl net annually. Put another way, in 1939 we exported nearly 10 per cent of our production of oil, whereas in 1950 we imported more than 10 per cent of our production to meet domestic demand.

The United States undoubtedly will remain a net importer of petroleum in the years immediately ahead. In fact, our imports are likely to increase. The one big reason for this is that the United States continues to account for about 60 per cent of the total world consumption of oil, while we have within our borders only about one-third of the world's proved oil reserves. Defense requirements as well as a sound conservation policy dictate as large a utilization of foreign crude oil supplies as is economically feasible.

In 1949, when the normal 5 to 6 per cent increase in domestic oil consumption failed to materialize because of the brief business recession, there was considerable pressure in Congress, originating chiefly with independent oil producers, for legislation restricting oil imports. Fortunately, these efforts failed because the 1950 business upturn, coupled with the Korean crisis, pushed domestic demand for oil up 10 per cent above previous high levels.

There are other forceful reasons besides conservation for encouraging rather than discouraging oil imports. Due primarily to natural factors, it is far cheaper to produce crude oil in foreign fields than in most continental U. S. fields. In the United States, man must work to bring the oil to the surface, while in the Middle East it literally gushes forth. All of the Middle East wells are natural flowing, and at the end of 1949 the 323 active wells in that area averaged 4600 bbl per day each. In the United States, the 421,000 wells averaged only 12 bbl per day each and only 11 per cent of them did not require pumping.

TABLE 1. U. S. imports and exports of crude oil and refined products, 1939, 1945-50. (Thousands of barrels daily.)

Year	Imports			Exports		
	Crude oil	Refined products	Total	Crude oil	Refined products	Total
1939	91	71	162	197	320	517
1945	203	108	311	90	414	504
1946	236	134	370	112	302	414
1947	267	170	437	126	325	451
1948	353	160	513	109	260	369
1949	424	231	655	91	237	328
1950[1]	490	354	844	88	200	288

[1] Fourth quarter 1950 imports and exports estimated.
Source: U. S. Bureau of Mines.

TABLE 2. World petroleum production and consumption by hemispheres. (In millions of barrels daily.)

	1938	Per cent total	1949	Per cent total
Production	5.575		9.73	
Western hemisphere	4.310	77.5	7.295	75
Eastern hemisphere	1.265	22.5	2.435	25
Consumption	5.585		9.740	
Western hemisphere	3.580	64.1	6.850	70.3
Eastern hemisphere	2.005	35.9	2.890	29.7
Refinery capacity	6.920		10.980	
Western hemisphere	5.195	75	8.025	72.7
Eastern hemisphere	1.725	25	2.955	27.3

Source: The Harvard Business Review, September 1950.

Fortunately, U. S. oil companies control approximately 31 per cent of the world's proved oil reserves outside of the United States, which gives U. S. companies control of oil resources approximately proportionate to U. S. oil consumption. U. S. oil companies have invested about $3.5 billion in overseas oil fields and facilities.

About 70 per cent of our crude oil imports come from Venezuela and Colombia, and the remainder from the Middle East. Almost all of our imports of refined products consist of distillate fuel oil from the Dutch West Indies. Venezuela, which is only 2000 miles away by tanker, undoubtedly will continue to be our main source of imported crude.

About 50 per cent of our oil exports today go to nearby Canada, Mexico, and Cuba. Europe, which used to account for the major portion, now takes only 25 per cent of our exports and the rest go all over the world.

World Situation

Table 2, showing the distribution of world production, consumption and refinery capacity for petroleum for 1938 and 1949, shows again how both production and refining are shifting toward the Eastern Hemisphere. This shift in production has been anticipated ever since geologists first realized the tremendous potentialities of the Middle East fields. What is surprising in the table is the fact that consumption in the Western Hemisphere, which means mainly the United States, still is increasing more rapidly than in the Eastern Hemisphere, where Europe is the main consuming area. The increase is more rapid both in absolute and relative terms.

It had been assumed 10 years ago that oil consumption would increase more rapidly in areas where extensive use of oil was just beginning and more slowly in those areas, like the United States, which already were consuming large quantities. From 1940 to 1950, United States consumption increased from 1.233 billion bbl to 2.175 billion bbl annually, or 76 per cent. In the Eastern Hemisphere, in a similar period, consumption increased by only 44 per cent.

The increase in demand for motor fuel, which constitutes about 40 per cent of our consumption of petroleum products today, illustrates the tremendous increase in consumption here. In 1930, the demand for motor fuel was 395,000,000 bbl annually. By 1940 it had increased to 589,000,000 bbl, and by 1950 stood at 994,000,000, bbl, a 152 per cent increase in 20 years.

Western Hemisphere production is mainly in the United States and the Caribbean, and consumption is centered in the U. S., whereas in the Eastern Hemisphere, production centers in the Middle East and consumption in Europe. In relative terms, production and refinery capacity are increasing faster in the Eastern than in the Western Hemisphere, while consumption is increasing more rapidly in the Western. Overall, expansion of both production and refinery capacity is keeping pace with the increase in consumption.

U. S. production of crude petroleum totaled 898,000,000 bbl in 1930, 1.353 billion barrels in 1940, and

1.973 billion barrels in 1950. At current rates, 1951 production will total 2.2 billion bbl, or more than the record 2.02 billion in 1948.

It is difficult to believe, however, that this rate of increase in U. S. production can be or should be continued in the future, in view of the great shift in recent years in the volume and location of the world's proved oil reserves. World proved oil reserves have more than doubled since 1938, from 34 to 78 billion barrels. The great increase was in the Middle East, which accounted for only 15 per cent of proved world reserves in 1938 and jumped to 41 per cent in 1950. U. S. reserves, even though they increased from 17.3 to 25.9 billion barrels in the same period, dropped from 51 to 33 per cent of the world total.

Even so, probabilities are that only a fraction of the Middle East potential reserves have been proved. Their magnitude is illustrated by a single field, the Burgan in Kuwait, which contains 11 billion barrels, or nearly one-seventh of the world's total proved reserves. Furthermore, to prove the first 10 billion of reserves at Burgan, only 13 wells had to be drilled, whereas 248,000 wells were drilled in the United States to prove the first 5 billion barrels of our reserves.

World and U. S. Fleets

The world tanker fleet, as shown by Table 3, has grown in the 11 years from 1939 to 1950 from 16,900,000 to 25,300,000 deadweight tons, an increase of approximately 50 per cent. Because of the higher speeds of postwar tankers, the actual carrying capacity of the world fleet probably has increased considerably more, about matching the 75 per cent increase in world oil production that occurred during the same period.

The most rapid increase in oil production now is occurring in the Middle East, which requires long hauls by tanker to consuming markets, so that world tanker requirements are likely to continue to increase. The world fleet is comparatively young. More than two-thirds of the vessel tonnage is under 10 years old, less than 15 per cent is over 21 years old, and less than 10 per cent is over 26 years old. With no slackening of demand in sight and at the present rate of building, the world fleet easily should reach 28,000,000 deadweight tons by the end of 1952.

One disturbing fact facing the oil industry is the close age grouping of the present world fleet, much of it war-built. A large part of it will become worn out at about the same time. Vessel replacement costs seem to be on a steady upgrade and depreciation reserves will be inadequate to pay them, while high taxes make it difficult for operators to accumulate the needed funds from other earnings.

Table 4 shows how the U. S. tanker fleet has increased in the same period from 4,258,000 to 6,976,000 deadweight tons, the largest increase of any nation. Panama, which increased its fleet from 734,000 to 2,819,000 tons, showed the next largest increase, with the United Kingdom third. The United States portion of the world fleet increased from 25.2 per cent in 1939 to 27.6 per cent in 1950.

Table 3 shows, however, that the increase in the U. S. fleet has been almost entirely in the foreign trade, where foreign flag competition will hit hard as world tanker supply and demand begin to approach a balance. Tanker tonnage in the U. S. domestic trade, where it is protected against foreign flag competition, increased only 294,000 tons in the 11 years, while the U. S. flag fleet engaged in foreign trade jumped 2,245,000 tons, from only 304,000 tons in 1939 to 2,549,000 tons in 1950. Unfortunately, it is this segment of the American flag fleet that is vulnerable to foreign flag competition. The fact that U. S. tanker tonnage declined 7 per cent from 1948 to 1950, while world tonnage increased 10 per cent, is a portent of what is likely to happen in the future when the present emergency shortage of tankers subsides.

Pipelines and Tankers

Two factors are likely to operate to ease the present worldwide shortage of tankers and hence stiffen the foreign flag competition faced by the U. S. fleet in the next few years. One is pipe lines in the Middle East and the other is the tremendous tanker-building program still in progress.

More than 40 per cent of the merchant shipping on ways today is tankers, and the proportion shows no signs of decreasing in the months ahead. As of December 31, 1950, there were being built in the world's shipyards 178 tankers of approximately 3,000,000 deadweight tons, and plans for building another 100 tankers were in process.

The great bulk of these new tankers will operate under foreign flags and compete with American flag tankers in the foreign trade. The effect on the American tankers engaged in foreign trades cannot help but be very serious.

In addition to this, construction of additional pipe lines from the Middle East oil fields to the eastern Mediterranean in the next few years will cut considerably into the demand for tankers in the foreign trades. The advantages of pipe lines 600 to 1000 miles long in the Middle East over tankers that must travel 3500 miles through the Red Sea and Persian Gulf, besides paying Suez Canal tolls, are so obvious that several lines have been planned almost from the initial discovery of the fields. A small-diameter British line from Kirkuk to Tripoli has been in operation since 1933. The big American-financed Tapline from the Saudi Arabian fields to Sidon, Lebanon, has been completed at a cost of $200,000,000. Now in capacity op-

TABLE 3. Total world tanker fleet and United States flag tanker fleet on December 31, 1939, December 31, 1948, and December 31, 1950.

(Excluding vessels under 1000 gross tons, vessels on the Great Lakes and inland waterways, and vessels owned by the military.)

(Tonnage in thousands)

	12/31/39		12/31/48		12/31/50	
	No.	DWT	No.	DWT	No.	DWT
Total world fleet	1,661[1]	16,912[1]	1,963	22,971	2,071[2]	25,261[2]
Total U. S. fleet	372	4,108	519	7,421	467	6,862
Active vessels	365	4,052	465	6,932	432	6,591
Foreign trade	27	304	187	2,976	158	2,549
Domestic trade	338	3,748	278	3,956	274	4,042
Inactive vessels	7	56	54	489	35	271
Temporarily inactive	7	56	29	321	12	104
U.S.M.A. reserve fleet	.....	.....	25	168	23	166

[1] As of September 1, 1939.
[2] As of June 30, 1950.
Note: The entire U. S. Flag fleet was privately owned as of December 31, 1939. As of December 31, 1950 all but 23 vessels of 166,000 DWT were privately owned.
Source: U. S. Department of Commerce, Maritime Administration.

TABLE 4. Merchant tanker fleet of the world—prewar and postwar.

(Includes seagoing vessels over 1000 gross tons including whaling tankers but excludes tankers owned by the armed forces or operating on the Great Lakes or inland waterways.)

Country	September 1, 1939		June 30, 1950	
	No.	DWT (000)	No.	DWT (000)
United States	384	4,258	481	6,976
United Kingdom	431	4,294	495	5,585
Norway	266	3,131	273	3,716
Panama	54	734	192	2,819
Others	526	4,495	630	6,165
Total	1,661	16,912	2,071	25,261

Source: U. S. Department of Commerce, Maritime Administration.

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eration, the Tapline transports 315,000 bbl of crude daily over 1068 miles and has displaced the equivalent of 68 T2 tankers.

At the same time construction of a new Iraq Petroleum Company pipe line from the Kirkuk fields to Banyas, Syria, has begun. Barring shortages of pipe, this 32-in., 30-in., and 26-in. pipe line, 560 miles long, will be completed in about two years and will deliver approximately 360,000 bbl of crude oil per day to the eastern Mediterranean, displacing another 75 or more tankers.

The Super-Tanker

One of the developments of the postwar tanker-building program worth mention is the super-tanker — the giant tanker of 24,000, 26,000, and 28,000 deadweight tons. One or two of 32,000 tons are being built.

The 12,000-ton tanker had become typical in worldwide trading by the time World War II began, but during the war the United States built hundreds of 16,000-ton tankers, which today form the backbone of the world fleet. The sharp postwar jump in tanker size coincided with development of the Middle East fields, and the giants now are beginning to preempt the field for long-distance carriage of crude oil from the Middle East and the Caribbean to the refineries of Europe and the United States.

The super-tanker is a highly specialized vessel, but where it can be used it can haul oil at far less cost than the smaller conventional tankers. Its tremendous size, more than 600 ft long and drawing up to 34-ft loaded, limits its adaptability and the number of ports it can serve.

Fifty-one of these giant tankers have been built in American shipyards in the last three years. Unfortunately, all but four or five are under foreign rather than the American flag. There are two reasons for this. One is the higher operating costs under the American flag, which affects the supertankers because they are used entirely in the foreign trades. Second is the failure of the old Maritime Commission, under pressure chiefly from labor unions, to permit the operators to transfer an equivalent amount of old tanker tonnage to foreign flags in return for placing the new and faster giants under the American flag. Such a transfer finally was approved for Standard Oil of New Jersey, which did place four of the giants under the U. S. flag. But American tanker operators, with prospects what they are for our tanker fleet, could not afford to place the new vessels under the American flag unless permitted to transfer the same amount of older tonnage.

The 1951 Southwestern Gas Measurement Short Course, Norman, Oklahoma, had in attendance nine representatives from five foreign countries. Seated left to right: Homer N. Mead, Venezuela; L. A. Prud'Homme, Canada; K. O. Rubie, Canada; standing: C. La Verdure, Canada; H. W. Newby, Canada; Jose G. Trevino, Mexico. In attendance but not shown in the picture were Jean Seguret, Tunisia; J. Puech, Algeria, and W. F. Byers, Canada.

Military Requirements

Barring all-out war, it does not appear that the rearmament program or the fighting in Korea will have any tremendous effect on tanker supply and demand worldwide. Credit is due the U. S. tanker fleet and the Military Sea Transport Service for the way in which oil transport needs for Korea have been met without any disruption of domestic supply. From August 1 to November 30, 1950, MSTS transported 14,000,000 bbl of oil and oil products to Korea, the equivalent of more than 100 T2 tanker loads. Recently the Maritime Administration has concluded an agreement with U. S. tanker operators providing a voluntary allocation system that will assure filling all military requirements.

In the overall oil picture, however, military demands even under the big defense program are unlikely to cause any serious shortages in the United States. The Korean war raised U. S. military demand for petroleum from 35,000,000 to 51,000,000 bbl in the last half of 1950. At this rate, the annual military demand would be less than 20 days of domestic production, now running at the rate of over 6,000,000 bbl daily. And domestic production could be expanded another million barrels daily in event of emergency.

There will be bottlenecks in a few products, like aviation gasoline of 100 octane and higher. The demand for this by the military jumped 100 per cent after Korea. The military demand now is at the rate of 32,000,000 bbl annually, whereas our total production in 1949 of 100 octane was only 35,000,000 bbl. Production can and will be increased and, generally, the oil industry is in excellent shape to meet the emergency, both as regards production and transportation.

Conclusion

Despite the present abnormal demand for tankers and the recent increase in the active fleet under the U. S. flag, the long-range prospects for the one-third or more of the American tanker fleet engaged in the foreign trades do not appear bright. Although we undoubtedly will maintain a larger fleet in these trades than we did prior to World War II, the higher operating costs of the American operator and the increasingly intensive competition in the foreign trades certain to flow from the huge increase in the worldwide tanker fleet will make it more and more difficult for U. S. flag tankers to remain in the foreign trades in their present numbers.

This report was prepared by the Association of American Ship Owners.

* * *

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Sacks of barium sulfate and cement being taken to the mixing equipment on a belt conveyor.

USE OF BARYTES ON PIPE LINES

Methods of applying treatment to pipe laid in rivers, swamps, marshes, and in open water

FRANK H. LOVE*

WITHIN recent months there has been an increasing use of barytes to give added weight and protection to pipe used in river crossings, marshy areas, swamps, and open water. Barium sulfate, because of greater specific gravity, is used as aggregate instead of sand and gravel. Greater weight can be obtained in this manner without going to an excessively thick coating.

The operating company, in all instances, determines the percentage of barytes that will be used in the aggregate, based on what negative buoyancy is desired. Barium sulfate may be used 100 per cent in the mix with cement, it may be 75 per cent barytes and 25 per cent sand and/or gravel, or some other combination as conditions dictate. The more sand and/or gravel, of course, the thicker the coating must be, so the mix is determined by how thick the coating can be to satisfy conditions, as well as cost limitations. Another consideration is the fact that if the coating becomes too thick it tends to defeat its own purpose, as the greater the diameter of the pipe with coating, the greater tendency it has to float. Condition of the soil in which the pipe will be buried also is a factor that must be kept in mind when determining the weight of the coating.

Barytes, barium sulfate ore mined principally in Missouri and Arkansas, has a specific gravity of 4.3, compared with a specific gravity for sand and gravel of approximately 2.5. Bulk density of barium sulfate is from 190 to 210 lb per cubic foot, whereas the bulk density of sand and gravel is about 143 lb per cubic foot.

Several methods have been devised

*Editor, *Oil and Gas Pipelining.*

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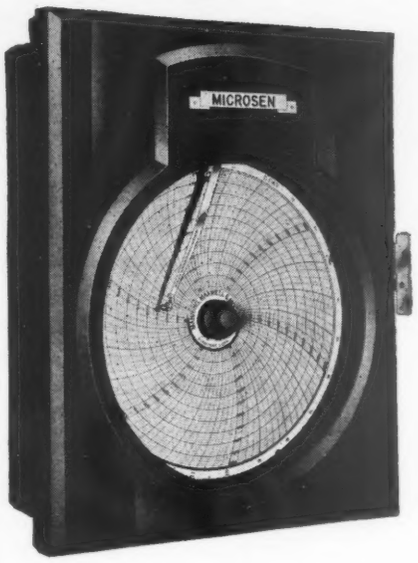

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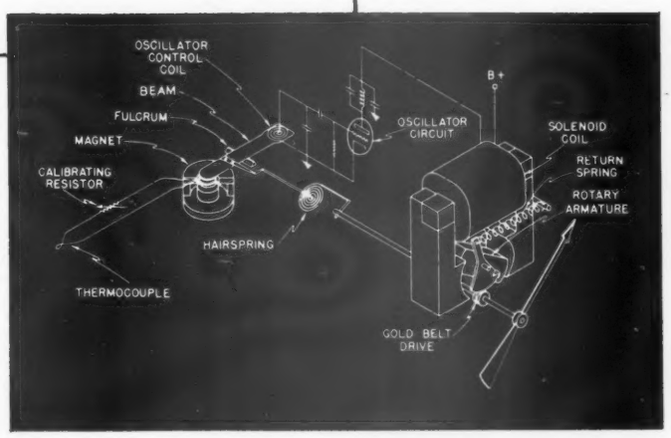

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Any change in thermocouple input deflects the Microsen beam and changes the proximity of the beam's flag end to the oscillator coil. The oscillator circuit then detunes and creates a current change through the vacuum tube and solenoid coil.

As the solenoid armature rotates, it positions the pointer so that the hairspring torque is opposed and equal to the input torque. The mechanical indication is thus weighed in exact proportion to thermocouple input. Consequently, the pointer accurately indicates the temperature on the dial.

MICROSEN BULLETIN 404 contains details about these revolutionary new temperature measuring instruments. Also included is information about Microsen Electric Indicators and Recorders for other fields of measurement. Write for a copy.

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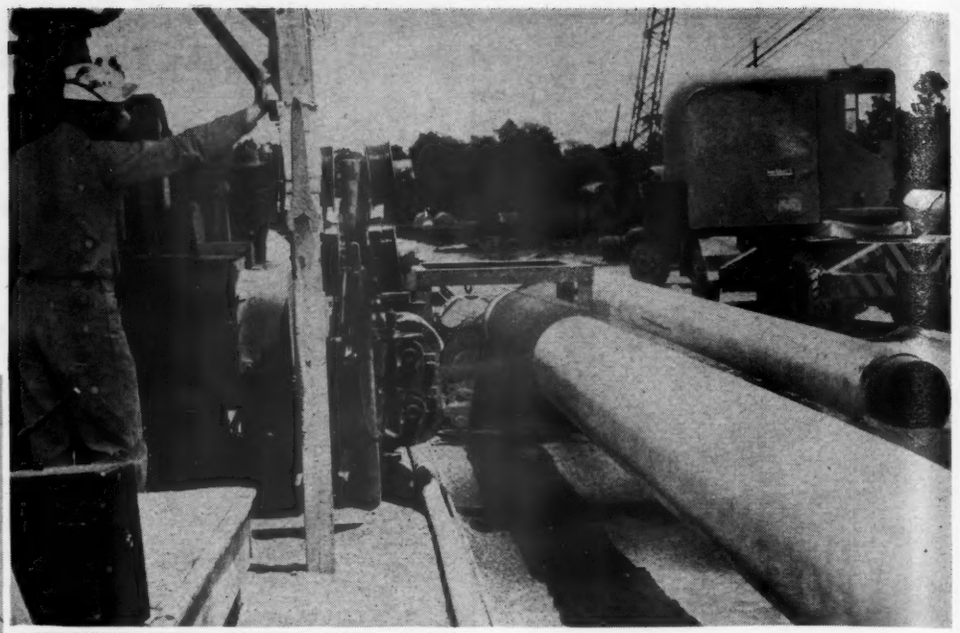
Applying barium sulfate-cement mix to pipe by the centrifugal or horizontal method.



Stacking pipe after it has been coated.

for the application of barium sulfate to pipe, which will be discussed in this article, and, it should be remembered, that in all cases the barytes-cement mix is applied after the pipe has first been coated with enamel or mastic. As stated, the barytes-cement coating is for the purpose of adding weight and providing additional protection for the pipe. Another consideration, and one of considerable importance in these days of steel restrictions, is the fact that with a heavy coating of this type, wall thickness of the pipe need not be so great as it would otherwise.

Centrifugal Method

In the centrifugal or horizontal process the mix is "sprayed" on the pipe, so to speak, by means of a high speed rubber disk. The mix is fed to this disk by a positive feed screw conveyor, making possible a uniform coating thickness. The joint of pipe while being coated is supported on each end by rubber rollers that rotate the pipe as it moves horizontally in front of the rubber disk. The mix is applied at high velocity, which serves two purposes: (1) Maximum compaction is obtained, and (2) holidays are eliminated. Thickness of the coating is governed by the speed of pipe rotation and can be controlled to a tolerance of 1/16 in.

Reinforcing is provided by 15-gage steel wire wound into the coating as it is being applied. Immediately above the rubber disk are the spools that feed the reinforcing wire. The wire is

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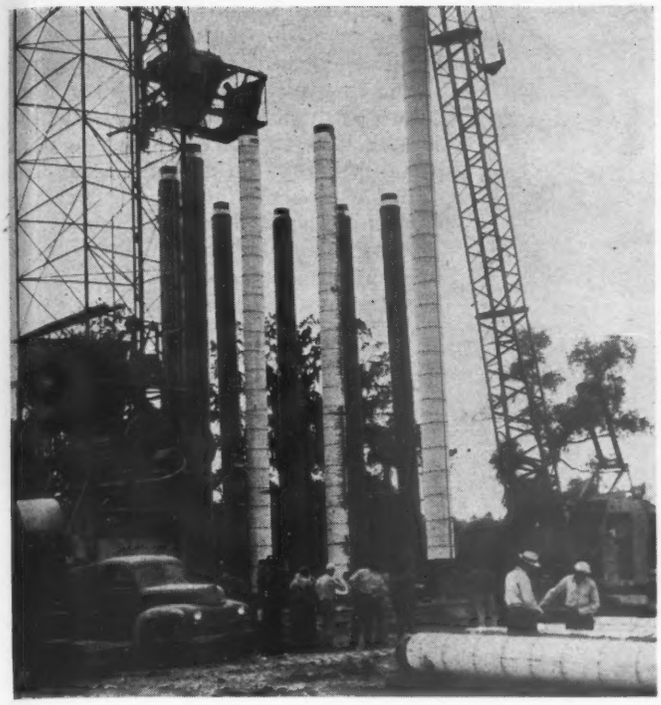
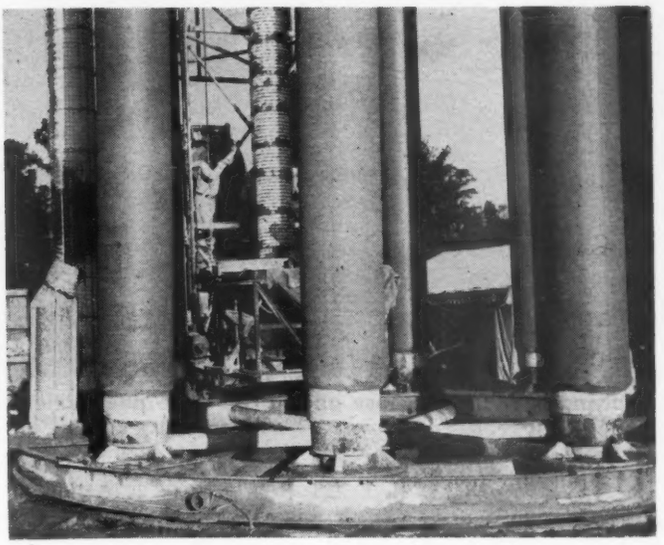


In the vertical method, pipe joints are placed in this manner on a turntable. At left is steel tower and hopper car, the latter containing the coating mix.

A closeup of the turntable used in the vertical method.



embedded into the coating in such a manner that it serves to resist tensile stresses, whereas the coating mix itself serves to resist compressive stresses. The spools can be placed at any desired depth in the coating, or one strand of wire can be embedded near the outside of the coating while the other is near the base.

One of the features of this machine is that it applies the coating mix in an almost dry state, which requires only 48 hours' curing time before the pipe can be handled and laid. Pipe from 4 in. to 30 in. in diameter can be coated and applications range in thickness from ¾ in. to 2½ in. From 3000 to 4000 ft of pipe can be coated in a day's time, depending on the thickness of the coating. The machines are portable.

Rosson-Richards Processing Company of Corpus Christi and Houston, Texas, employ the centrifugal process.

Vertical Method

When applying pipe-coating material containing barytes to the pipe while in a vertical position, as is done by the H. C. Price Company of Bartlesville, Oklahoma, it is first wrapped with a galvanized wire mesh. This serves as reinforcement and as a base for the material. The mesh used is 14-gage with 2-in. square openings. The pipe is then picked up by sidebooms and placed on a platform close to the coating equipment. A 70-ft boom handles the pipe, placing each joint on a large turntable equipped with 12 spuds, the latter holding the pipe in a vertical position. Adjoining the turntable is a 75-ft steel tower equipped with a hopper car that moves vertically up and down one side of the tower. The hopper car, of course, contains the material that is to be applied to the pipe. By rotating the turntable, the pipe joints are brought into line with the hopper side of the tower.

With the hopper car at the top of the tower, the pipe joint is placed through an opening in the bottom of

Wire mesh is used to reinforce the barium sulfate-cement coating mix.

Applying coating with hose and nozzle—the pneumatic method.

the funnel-shaped car, which is then lowered to the bottom of the pipe joint, the joint being held securely by an aligning spud at the top. The hopper is filled with enough mix to coat the joint of pipe, and, as it ascends driven by a 10-hp motor, the weight of the mix and the pumping action of vibrators attached to the hopper, force the mix out the bottom and onto the pipe. This procedure is repeated for each of the 12 joints of pipe on the turntable. Each joint remains on the turntable for approximately 30 minutes to allow for early set of the mix before being unloaded and laid out for overnight hardening. One plant averages about 100 joints of pipe a day, which is approximately 4000 ft of pipe per 8-hr shift.

Price has recently gone to the use of the horizontal method of application on pipe larger than 22-in. in diameter, because of the extreme weight of this size pipe. In this method the pipe is rotated and the mix applied to it by centrifugal force, in a manner similar to that already described.

Pneumatic Method

Pneumatic application is by means of hose and nozzle, much on the order of spray painting. The trademarked name of this method is Guniting and is employed by the Flanders Construction Company of Houston, Texas. Application can be made from any angle and to straight or curved pipe. Usual procedure is to "shoot" half the pipe, let it set, then turn and shoot the other half. Before the coating is applied, however, a reinforcing wire mesh is wrapped around the pipe and furred out to about half the thickness of the baryte-cement mix.

On most large diameter pipe 4 by 4 or 3 by 3 10-gage welded wire mesh is used. In some instances this is overlaid with a 2 by 2, 14-gage wire mesh.

In applying, the material is fed by a conveyor to a mixing hopper in the bottom of which is a hand-operated, quick-opening gate through which the dry mixed material drops into the cement gun and is forced through the hose by 60-psi air pressure. Water is brought to the nozzle of the hose by a separate hose and under high pressure. The water comes into the nozzle body back of a water ring that contains 14 holes and is mixed with the barytes-cement material a split second before it hits the pipe. The nozzle man, by means of a valve, controls the amount of water that enters the mixture, his judgment based on experience determining the volume. The coating mix, however, is automatically regulated as to the amount by the constant-feed mixing unit. The amount of water used in this process approximates 12 per cent of that used in a conventional mix of concrete, which gives high early strength and quick set. Compressive strength regularly obtained with a 50-50 mix of barytes and sand and a 4:1 ratio mix with cement is 8000 to 9000 psi.

Jobs are usually handled with 2-gun or 4-gun setups. One gun, on an average, will apply coating to about 20,000 lineal feet of 24-in. pipe per day.

* * *

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Natural Gas in Relation To National Defense*

While showing that this natural resource is contributing greatly to making of war materials, an answer also is given to those who think we are consuming it too rapidly.

PAUL KAYSER

In appraising any commodity in relation to the national defense program, two things must be borne in mind:

1. To what extent does the commodity contribute to the production of munitions and other war materials and to the actual training of troops; and

2. To what extent is it necessary for the maintenance of the economy at a high productive level.

Natural gas fulfills both of these requirements.

Copper is one of the most important materials for the production of munitions. Natural gas supplies the fuel for the production of more than 80 per cent of all copper produced in the United States.

Potash is an important substance in the manufacture of explosives and in the production of fertilizers to maintain high agricultural production. Natural gas supplies the fuel for the production of 95 per cent of the potash produced in this country.

More than 50 per cent of the great plants of the chemical industry are situated on the Gulf Coast of Louisiana and Texas because of access to large volumes of natural gas at low cost from the vast gas fields of that area. No war can be fought successfully and no economy can be maintained in modern times without a vigorous and expanding chemical industry. Natural gas is essential for this purpose.

In the making of steel, natural gas is an absolute essential in certain heat-treating processes. It is imperative that the steel mills all over the country — in Pittsburgh, Youngstown, Gary, Chicago, Houston, Salt Lake, Los Angeles, and San Francisco — have dependable and expanding quantities of natural gas to maintain an expanding steel production, the most vital sinew of defense.

Natural gas is playing an increasing part in the production and processing of aluminum as witnessed by the fact of the delivery of large volumes of gas per day for use in aluminum plants in Tennessee and the recent location in the Corpus Christi area of an aluminum plant to use 50,000,000 cu ft of gas per day for the production of aluminum for the defense program.

In respect to the actual training of troops, the Southwest, including California, is the greatest training ground in the entire country. The vast majority of training camps were in this area in the last war and many are being reactivated at this time. In practically all these camps natural gas was the fuel used and this demand must be met as these camps are put back into service. From the standpoint of the pipe line, they are not a desirable load but from the standpoint of the military authorities natural gas is the most efficient fuel because its use requires the minimum of the trainees' time, leaving the maximum time for military training.

In respect to the maintenance of the economy at a high productive level, the importance of natural gas is clearly shown by the percentage relationship between all sources of energy consumed in the country in the year 1949. In that year coal contributed 39.8 per cent, petroleum 36.6 per cent, water power 4.9 per cent, and natural gas 18.7 per cent.[1]

At the beginning of the last war in 1941, natural gas contributed only 11.1 per cent of the energy consumed in such year. This is an increase, since the beginning of the last war and up to 1949, of 70 per cent, but the trend indicates that at this time, 1951, the increase is more than 100 per cent.

The importance of the natural gas industry to the national economy is further shown by a comparison of utility sales of natural gas at the beginning of the last war and at the present time.

In 1941 the total utility sales of natural gas, in round figures, were 1 trillion, 569 billion (1,569,000,000,000) cu ft, whereas in 1949 such sales were 3 trillion, 107 billion (3,107,000,000,000) cu ft. According to the trend, the figure for 1950 will be more than double the figure for 1941. But more significant is the fact that the residential and commercial sales in 1941 were only 506 billion (506,000,000,000) whereas in 1949 such sales were 1 trillion, 213 billion (1,213,000,000,000) cu ft.[1] The sales for 1950 will be more than three times the 1941 sales, according to the known trend.

These users cannot readily substitute other fuels and their needs must be met if the economy is to remain vigorous and healthy. In addition, substantial expansion must be provided if the economy is to expand to meet defense needs.

Whether or not new lines are to

*Presented before the American Gas Association, Natural Gas Department, Dallas, Texas, May 7-8, 1951.

[1]Senate Document No. 8 of the 82nd Congress.

be built into new areas and the extent of the expansion of present systems in interstate commerce is a matter for the joint decision of the Federal Power Commission and the Petroleum Administration for Defense. This question should be decided on full consideration of all the facts in hearings before the FPC including the vital question of the availability of other fuels. The Natural Gas Act has not been repealed and the certificate provision of such act is as valid as it ever was and undoubtedly will continue in effect after this emergency has passed.

In respect to the mechanics of the participation of the natural gas industry in national defense, the president under the authority of the Defense Act has appointed the Secretary of the Interior the Petroleum Administrator for Defense. The secretary, by appropriate directive, has appointed Bruce K. Brown deputy administrator. Upon the request of representatives of the gas industry, an assistant deputy administrator has been appointed to have charge of all matters relating to gas, both natural and manufactured, except the production of natural gas. C. P. Rather, president of Southern Natural Gas Company and first vice president of the Independent Natural Gas Association, has been named to this position effective April 1.

In order to obtain advice and counsel from the industry, the secretary has appointed a Gas Industry Advisory Council, similar to the Petroleum Council for War. The first meeting of this advisory council was called for May 9.

I wish to say here, and I am sure I can speak for the entire industry, the appointment of the assistant deputy and the gas council is highly satisfactory to the industry and should promote a most efficient and cooperative implementation of the Defense Act in respect to gas. The assistant deputy administrator is a man of broad experience in the industry and is well qualified for this very difficult job. The council plainly has been carefully chosen from every phase of the industry and each section of the country is properly represented.

The natural gas industry is in excellent condition to meet its responsibility under the defense program. This fact was clearly developed at a meeting recently held in Washington.

National Fuel Policy

On March 7 and 8, Senator O'Mahoney, chairman of the Senate Committee on Interior and Insular Affairs, called a meeting in Washington of a panel for the discussion of the available fuel resources of the nation and the formulation of a national fuel policy in respect thereto. The following persons made up the panel:

Max Ball, oil and gas consultant of Washington, D. C.

John Battle, president, National Coal Association.

Ivan Bloch, consulting engineer of Portland, Oregon.

William H. Cooke, chairman, Coal Committee for Defense, Chicago, Illinois.

Frank Earnest, president, Anthracite Institute.

J. Ed Warren, president, Independent Petroleum Association of America, substituting for Harold B. Fell, executive vice president of that association.

Eugene Holman, president, Standard Oil Company of New Jersey.

A. Jacobsen, chairman, National Oil Policy Committee, American Petroleum Institute.

Paul Kayser, president, Independent Natural Gas Association of America.

L. G. McCollum, president, Continental Oil Company.

C. J. Potter, president, Rochester and Pittsburgh Coal Company.

Ralph E. Taggart, president, Philadelphia and Reading Coal and Iron Company.

Dr. Robert E. Wilson, chairman of the board, Standard Oil Company of Indiana.

On the Committee, in addition to Chairman O'Mahoney, there were present Senators Ecton (R) of Montana; Long (D) of Louisiana; Anderson (D) of New Mexico; Cordon (R) of Oregon, and Butler (R) of Nebraska.

Prior to the meeting there was sent to each member of the panel a copy of Senate Document No. 8 of the 82nd Congress entitled "Basic Data Relating to Energy Resources," a monograph containing a most comprehensive compilation of useful data on the coal, power, oil, and gas resources of the United States.

A most intense discussion was carried out between members of the panel, the chairman and senate members of the committee for a period of two days. The representative of each of the industries spoke many times and all the important phases of the various industries were covered in the discussion.

The coal industry urged that the government should adopt a policy of restriction on the further expansion of the use of oil and gas except for certain special uses designated by them, the "mobile" uses principally, and the use of coal for all other purposes. When pressed by the representatives of the oil and gas industries as to whether they favored the government telling the consumer what fuel he could use, they always sidestepped and said the government should "encourage" the use of coal in all cases where coal was available.

The building of synthetic plants *now*, with government help, to make all types of liquid and gaseous fuels was advocated by the coal interests. The answer of the gas industry to this restrictive policy, presented to the panel and members of the Senate Committee, is the same answer I present to you.

Proved Gas Reserves

The proved reserves of natural gas will support the present rate of production in this country for a period in excess of 26 years but the rate of discovery of reserves exceeds consumption on the average by more than double the consumption. This is clearly illustrated by the following table covering the past five years.[2]

Millions of cubic feet—14.65 psia at 60 F

Year	Estimated proved reserves as of end of year	Total of discoveries revisions and extensions	Net production during year	Increase over previous year
1946....	160,575,901	17,729,152	4,942,617	12,786,535
1947....	165,926,914	10,980,824	5,629,811	5,351,013
1948....	173,869,340	13,898,572	6,007,628	7,942,426
1949....	180,381,344	12,674,299	6,245,041	6,512,004
1950....	185,592,699	12,104,699	6,892,678	5,211,355

The last 5-year period has been the period of greatest expansion in the history of the natural gas business and yet during that period the proved reserves of natural gas, after consumption, have risen from 160 trillion cubic feet to 185 trillion cubic feet. Thus, despite the phenomenal increase in the use of this commodity, the known reserves have increased more than 25 trillion cubic feet.

So long as this trend continues there is no occasion to be concerned about the exhaustion of the reserves. So long as this trend continues there is no necessity to construct or put in operation plants for the production of synthetic high Btu gas from either coal or oil shale. The technology of the construction and operation of such plants should be fully developed as rapidly as such technology can be advanced but so long as the reserves are rising each year there is certainly no occasion to put such plants into commercial production.

The natural gas industry has been accused by some of its opponents of having displaced other fuels and, therefore, of having disrupted the national economy by substituting a natural resource with a more limited

[2]Report of AGA Committee on Natural Gas Reserves.

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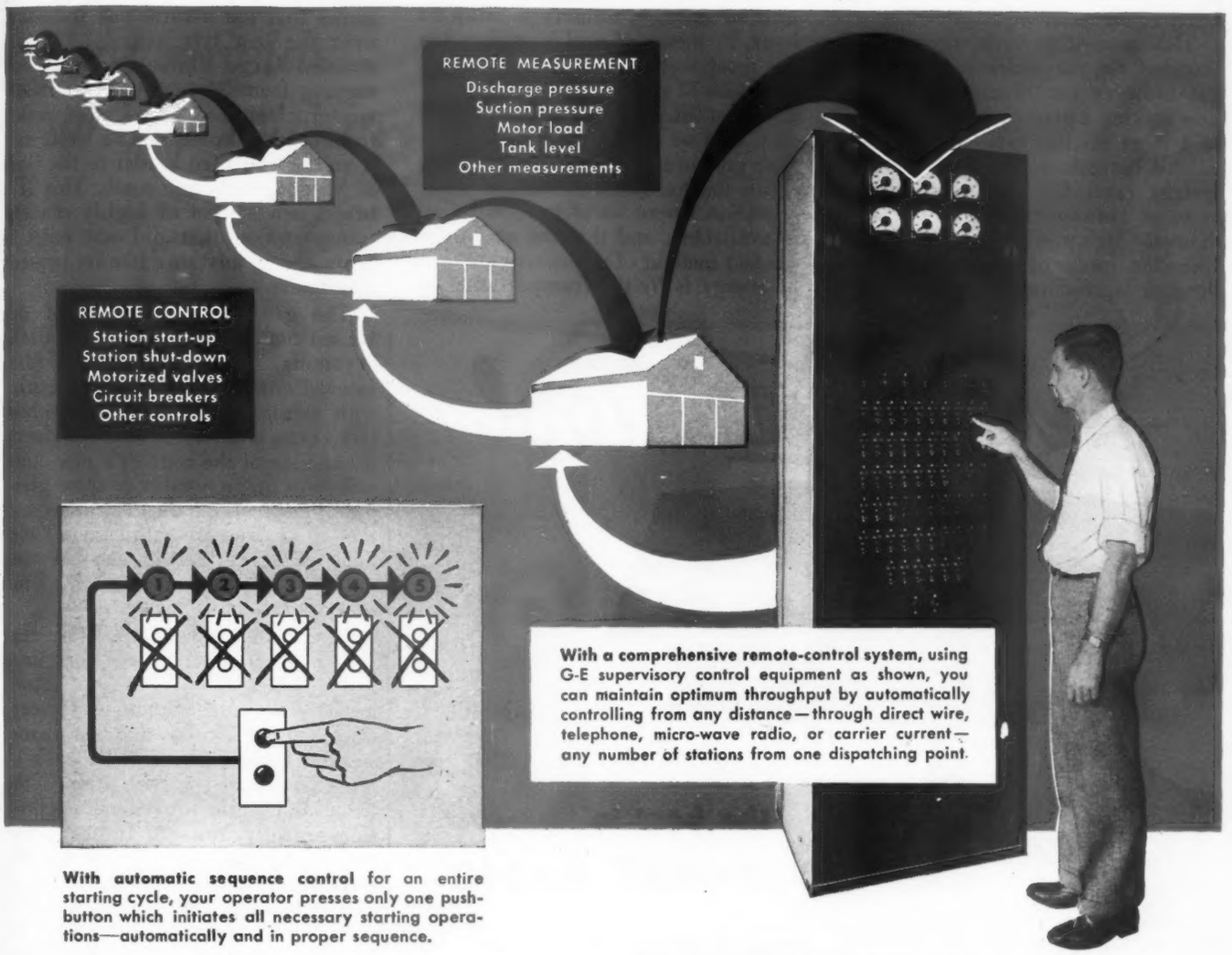
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With a comprehensive remote-control system, using G-E supervisory control equipment as shown, you can maintain optimum throughput by automatically controlling from any distance—through direct wire, telephone, micro-wave radio, or carrier current—any number of stations from one dispatching point.

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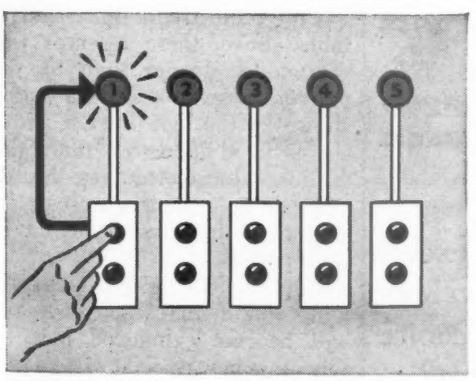

With convenient push-button operation, your operator controls individual motors from any desired location. Interlocking of control can take the responsibility for starting and stopping valve motors, blower motor, and main pump motor in proper succession.

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life than the one displaced and from this they have reasoned that expansion of the natural gas industry should be curbed in the interest of the stability of our economy.

This accusation is in nowise well founded. On the contrary, the natural gas industry has in the past and is now making a permanent contribution to a more efficient economy than has existed heretofore. By taking present freight rates for coal and present costs of transporting gas by large diameter high pressure pipe lines and, likewise, costs of transporting oil through large diameter high pressure pipe lines, it can be demonstrated—and I have had competent engineers draw the charts making such demonstration—that the transportation of a unit of energy, namely a kilowatt hour, by means of coal by railroad is the most inefficient method of transportation of such unit of energy; that the most efficient transportation of such unit of energy is that of oil by high pressure large diameter pipe line (with the exception of tanker transportation where water transportation is available), and that the next most efficient method of transporting a unit of energy is by the transportation of 1000 Btu natural gas by high pressure large diameter pipe lines.

A casual view of the natural gas pipe lines map of the United States shows that the natural gas industry, over the last five years, has constructed large diameter pipe lines varying from 24 in. to 36 in. in diameter, clear across the United States from coast to coast, east to west, and from the Canadian border to the Gulf of Mexico, north and south. This is a brand new system of highly efficient transportation that did not exist 6 years ago in anything like its present magnitude.

The great coal reserves of the United States are in Colorado, Utah, Wyoming, Montana, Illinois, Missouri, Pennsylvania, and Virginia, with substantial amounts in Tennessee, Texas, and New Mexico. A glance at the map of the country's pipe lines will show that a number of these great pipe lines traverse the coal areas and that all of them are within such a distance that they easily can be connected to plants at the mouth of the mines.

Under the rules of the Federal Power Commission these pipe lines are projected upon the basis of known gas reserves and, without any exception so far as I know, the debt financing has been done upon the basis of amortization of the debt prior to the exhaustion of the proved gas reserves. Consequently, the gas industry has built and is building a great new efficient system for the transportation of energy that has been soundly financed and will be amortized completely by the time of the exhaustion of the present proved reserves of natural gas.

Under the trend illustrated by the table above, these reserves will last very much longer than the present proved reserves indicate. This is shown by the fact that the proved reserves have increased more than 25 trillion cubic feet during the last five years in spite of the increase in consumption that has occurred during such period.

Nevertheless, within reason there will come a time when these reserves will become exhausted but, at that time, this new efficient system of transportation will be available for connection to huge plants, built at the mouth of the mine, which will make synthetic gas of approximately 900 Btu content that will be transported to market and delivered to the same burners that are now using natural gas. So that, in fact, by using our present known gas reserves and by developing additional reserves through new discoveries, as has been done continuously in the past, we are constructing a vast transportation system that will make energy

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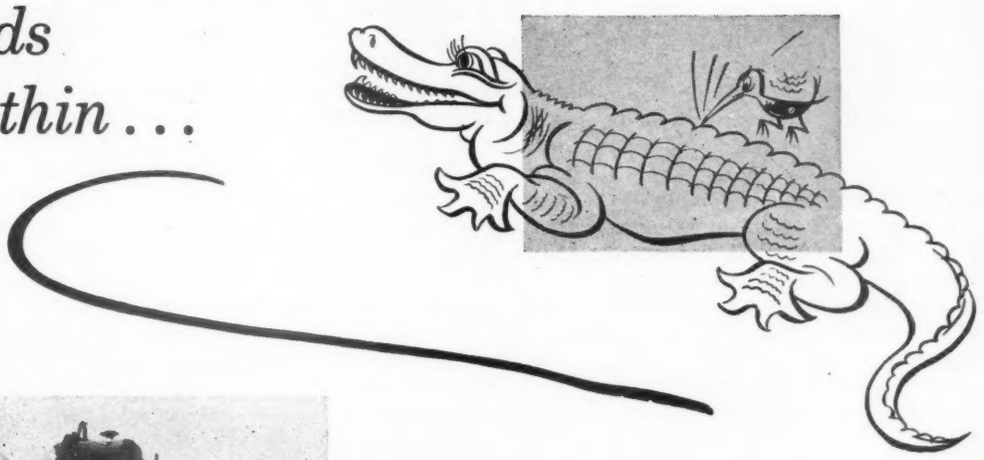

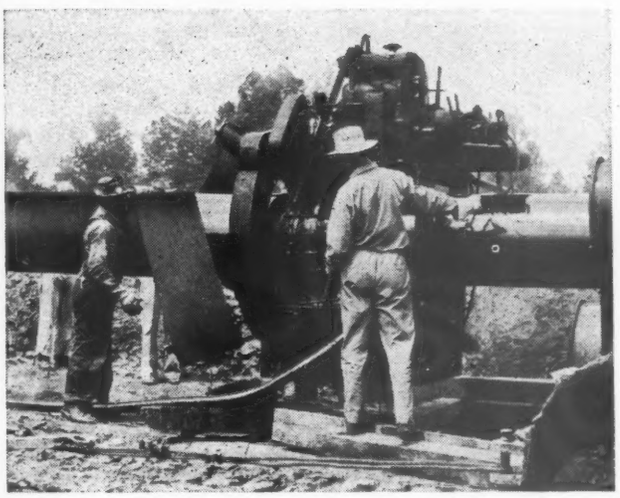

Johns-Manville Asbestos Felts shield oil and gas pipelines

Johns-Manville Asbestos Pipeline Felt—*the only type of wrapper that has survived more than 50 years of service in all types of soil*—now protects more than 100,000 miles of oil and gas pipelines!

A sturdy, inorganic product, Johns-Manville Asbestos Felt resists rot and decay, stands up in both acid and alkali soils. It has the thickness and toughness needed to shield pipeline enamels from earth load and soil stresses. And it permits the protective enamel coating to properly function against corrosion.

Johns-Manville Asbestos Felt is flexible; wraps easily without cracking. It guards enamel from impact damage both during installation of field-wrapped pipe, and during transportation and installation of mill-wrapped pipe.

There are important economic advantages, too! In addition to reducing maintenance expense, Johns-Manville Asbestos Felt adds many years of life to the pipeline. For further information and a sample of Johns-Manville Asbestos Pipeline Felt, mail the coupon below.

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available to markets in the most efficient manner and will make possible the utilization of the total energy resources of the United States at the least cost to the consumers.

Actually, the natural gas industry in developing and expanding as it has is *not* disrupting the nation's economy but is building a more stable and efficient economy for the use of our natural resources.

Technology for the construction and operation of synthetic plants has already progressed to the point that competent engineers tell us that most petroleum products and 900 Btu gas can be made from coal and oil shales. The Carthage Hydrocol plant at Brownsville is now engaged in developing the making of petroleum products from natural gas. The development of certain phases of this operation will greatly expedite the making of high Btu gas from coal. This is a major plant and has involved an expenditure in excess of $45,000,000 and is sustained by the oil and natural gas industries.

Further advances should be made as rapidly as human ingenuity can go but there is certainly no necessity to put such plants into commercial operation so long as our reserves are expanding more rapidly than our consumption. Whenever we turn over the hill of our gas reserves there will be time enough to construct and place in operation plants for the making of synthetic gas from the available resources of coal and oil shale.

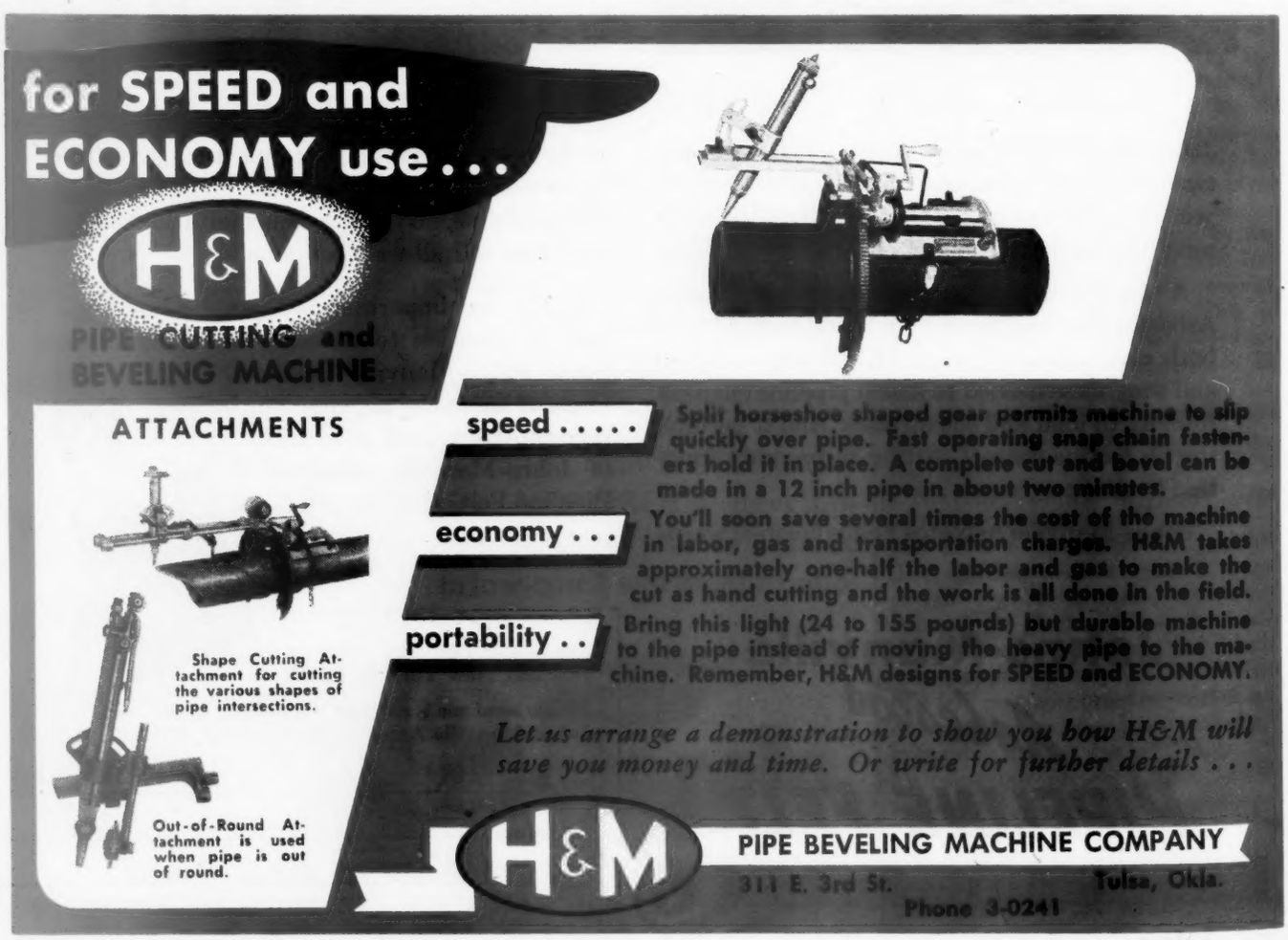
These considerations lead to the inevitable conclusion that the practical common sense thing to do is for us to continue to use the resources of natural gas and petroleum that we have because, in so doing, we are developing a system of transportation and marketing that will be available to take advantage of the use of synthetic fuels whenever such is necessary.

Under this state of facts we can freely use these resources for defense to the extent that is necessary without fear that we will be exhausting our national economy to the extent that after the emergency we will have to lower our standard of living. The fact is that under the spur of defense and under the spur of competition that exists in both the petroleum industry and the natural gas industry, technology has been advanced to the point where we can reasonably expect a greater utilization of these products and a greater advance in the technology of making available synthetic fuels than has occurred in the past, and we can reasonably expect to maintain as high, and even a higher, standard of living through the utilization of our energy resources in the future than we have had in the past.

The key to the high standard of living in this country is our highly developed use of its energy resources. As the coal representatives pointed out in the panel discussion mentioned earlier, the introduction of petroleum into our economy has changed its entire nature. As they stated, it has made it a "mobile" economy, referring particularly to the use of the automobile and the airplane. In fact, such revolution has occurred in nearly every application of power. This is clearly shown by the fact that the diesel engine already has almost entirely supplanted the steam engine on the railroads.

The point was made in the panel discussion that because we had become a "mobile" economy we should restrict the further expansion of the use of petroleum and natural gas and conserve them for these special uses. But the fact is that by using these resources of oil and gas, instead of hoarding them, we will have a system so developed that when these resources are exhausted we will be able to substitute in their place the synthetic fuels made from coal and shale and, therefore, maintain for the maximum time our high standard of living.

* * *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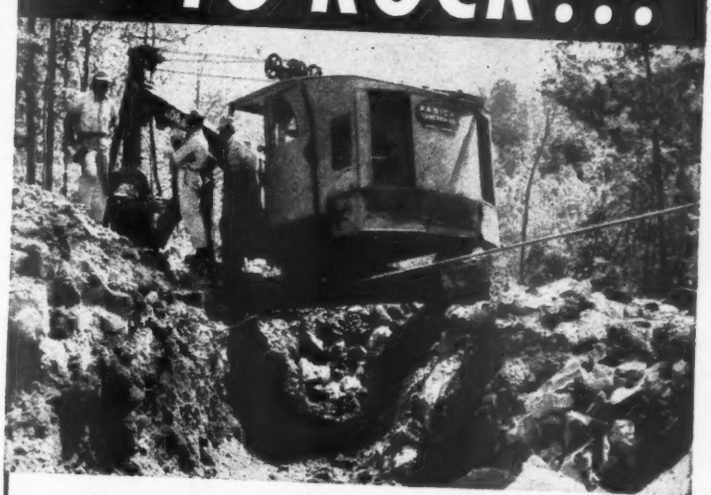

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And when it's a trench-digging job, Lorain "Pipeliners"—in Junior (¾ yd.) and Senior (1 yd.) models—have set the pace on pipelines across the nation. Extra-wide crawlers straddle trench, reduce the threat of cave-in.

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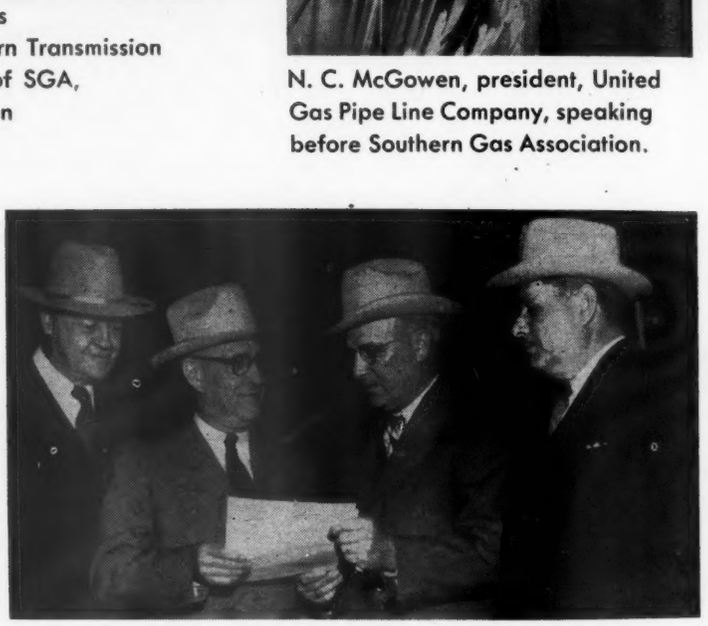
PICTORIAL

R. C. Ledford, The Marine Gathering Company, addresses Southern Gas Association. E. R. Cunningham, Texas Eastern Transmission Corporation, and chairman of the Transmission Section of SGA, is shown seated with A. L. Roberts, Texas Gas Transmission Corporation, who presided at the Transmission Session.

N. C. McGowen, president, United Gas Pipe Line Company, speaking before Southern Gas Association.

E. B. Dunn, Keystone Pipe Line Company, talked on microwave at SGA Transmission Session.



A commission as an honorary deputy sheriff was given Dr. W. R. G. Baker, pioneer radio and television expert, as he arrived in Dallas to speak at the annual conference of the PIEA. Left to right are W. B. Clayton, General Electric vice president; Dr. Baker, G-E vice president; Chief Deputy Sheriff Bill Binford, and Paul L. Chamberlain, manager of sales for the G-E Commercial Equipment Division.

Participants in the panel discussion of transmission operating problems at the Southern Gas Association meeting: W. A. Broome, Arkansas Louisiana Gas Company; G. Carl Cooper, Mississippi River Fuel Corporation; H. M. McDonald, Texas Eastern Transmission Corporation; E. D. Nuttall, United Gas Corporation; J. H. Echterhoff, United Gas Pipe Line Company; J. W. Carneal, Texas Gas Transmission Corporation; W. C. McGee, Jr., Tennessee Gas Transmission Company; Aubrey L. Roberts, Texas Gas Transmission Corporation; Carl E. Cloud, Oklahoma Natural Gas Company; E. E. Stovall, Lone Star Gas Company; and Louis R. Records, Sohio Petroleum Company, not in picture.

"Mack Boca Raton" soaks up Florida sunshine with Frank B. Smith, president of Refiners Transport and National Tank Truck Carriers Association, and Henry Rowold, vice president, Mack Motor Truck. The pup was won by S. F. Niness, Leaman Transportation at Carriers' mid-year meeting.

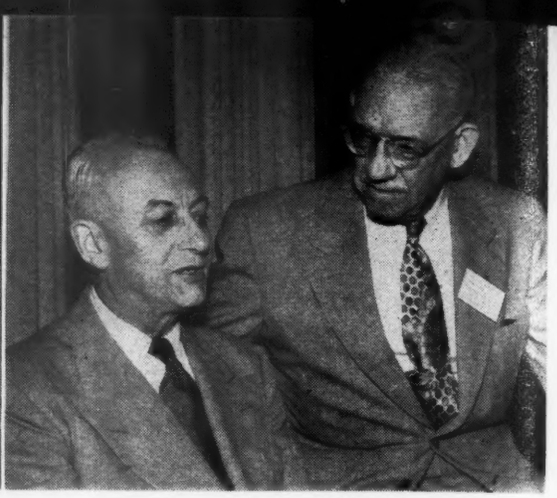
New coating machine, the Roskoter, which applies cold mastic in the field, was demonstrated recently by Royston Laboratories, Inc.

Others who saw Roskoter in action: Glenn Royer (press); Frank B. Costanzo, Manufacturers Light and Heat Company; William A. Irvine, Britton Contracting Company; Tom Royston, Royston Laboratories, and Dick Peifer, Peifer Corrosion Service, Carnegie, Pennsylvania.

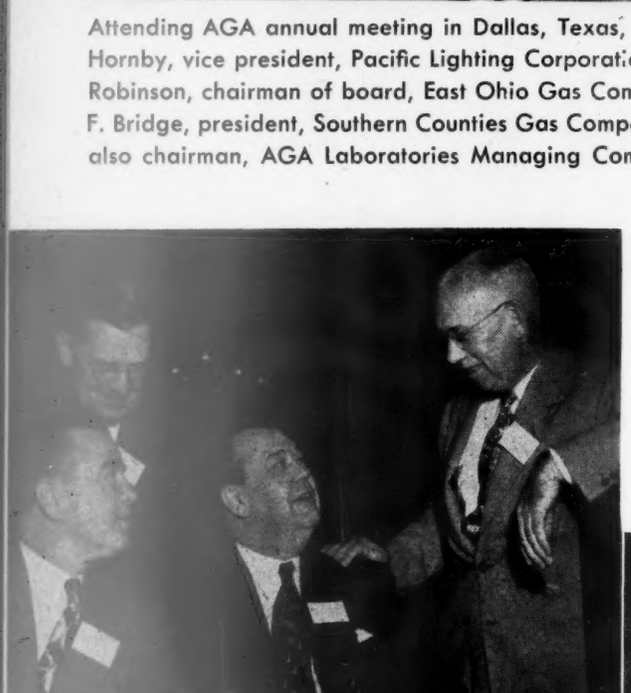
Among those present at Roskoter demonstration were: H. R. Britton, Britton Contracting Company, left; R. D. Cagney, Contracting and Material Company, E. H. Snashall, Ohio Fuel Gas; R. F. Selinger and N. P. Peifer, Manufacturers Light and Heat, and Jack Royston, Royston Laboratories.

Newly elected officers and directors of the Southern Gas Association chosen at the annual meeting in Biloxi, Mississippi: Charles Oxford, Gas Light Company of Columbus, Columbus, Georgia, director; H. K. Griffin, Mississippi Gas Company, Meridian, Mississippi, second vice president; H. V. McConkey, Southern Union Gas Company, Dallas, Texas, treasurer; E. L. Henderson, United Gas Corporation, Shreveport, Louisiana, director; Kyle Turner, Atlanta Gas Light Company, Atlanta, Georgia, assistant secretary; L. L. Dyer, Lone Star Gas Company, Dallas, president; J. H. Wimberly, Houston Natural Gas Corporation, Houston, Texas, first vice president; C. H. Zachry, Southern Union Gas Company, Dallas, vice chairman of advisory council; Charley Lockhart, Jr., Bryant Heater Division of A.G.E., Inc., Tyler, Texas, director; R. A. Puryear, Alabama Gas Corporation, Birmingham, director. Not present when picture was taken: J. L. Campbell, New Orleans Public Service Company, New Orleans, secretary; R. G. Taber, Atlanta Gas Light Company, Atlanta, chairman of advisory council; H. C. Webb, Oklahoma Natural Gas Company, Tulsa, director.

Attending AGA annual meeting in Dallas, Texas, were: Robert A. Hornby, vice president, Pacific Lighting Corporation; J. French Robinson, chairman of board, East Ohio Gas Company, and Arthur F. Bridge, president, Southern Counties Gas Company, Los Angeles, also chairman, AGA Laboratories Managing Committee.

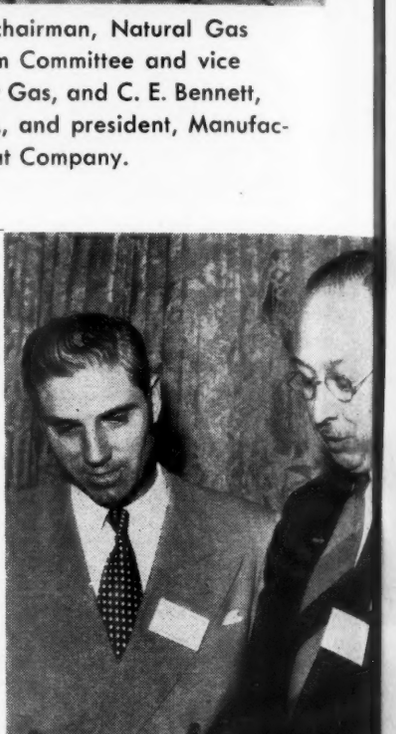


Elmer F. Schmidt, chairman, Natural Gas Conference Program Committee and vice president, Lone Star Gas, and C. E. Bennett, vice president, AGA, and president, Manufacturers Light and Heat Company.



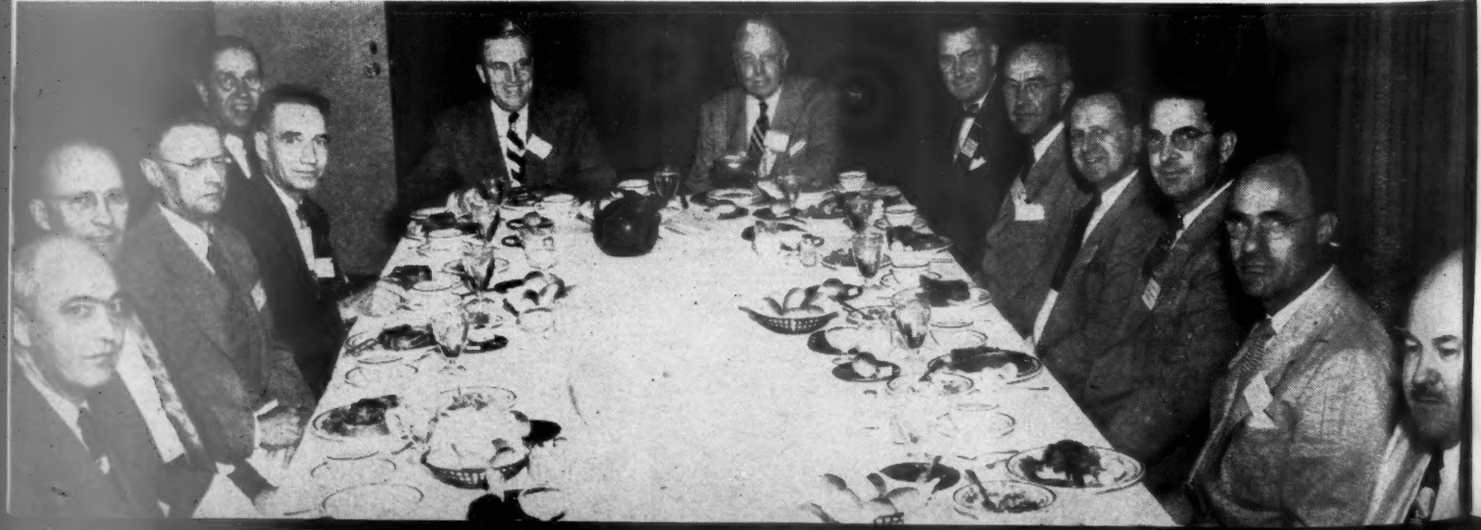
John E. Goble, president, National Tube Company; Frank H. Lerch, Jr., president, Consolidated Natural Gas Company; D. A. Hulcy, president, AGA and president, Lone Star Gas, and C. E. Bennett.

J. S. Quill, General Electric; J. E. Eichelmann, chief engineer, El Paso Natural Gas; M. L. Arnold, chief engineer, gas operations, Richfield.



H. A. Rhodes, superintendent of communications, Transcontinental, and A. B. Lauderbaugh, Manufacturers Light and Heat.

Meeting of AGA Transmission Committee. At head table are M. V. Burlingame, chairman, and George H. Smith, assistant managing director of AGA.



NEWS

Contractors' Association Committees Announced

Laurence H. Favrot, president of the Pipe Line Contractors Association, has announced the appointment of the following committees to serve during 1951:

Labor Committee — A. L. Forbes, Jr., Associated Pipe Line Contractors, Inc., chairman; T. A. Hester, Oklahoma Contracting Company; M. S. Williams, Anderson Brothers Corporation; Kenneth A. Owens, Williams Brothers Company; E. J. Mahoney, Jr., Mahoney Contracting Company, and Felix M. Johnson, Trojan Construction Company, Inc.

Membership Committee — Ray L. Smith, Ray L. Smith and Son, Inc., chairman; O. R. Burden, O. R. Burden Construction Company; C. C. Bledsoe, Midwestern Constructors, Inc.; Robert D. Sheehan, Sheehan Pipe Line Construction Company, and J. C. Britton, Britton Contracting Company, Inc.

Program Committee — James P. Neill, Western Pipe Line Constructors, Inc., chairman; Earl Allen, Associated Pipe Line Contractors, Inc.; Carl C. Anderson, Anderson Brothers Corporation; T. R. Jones, Oklahoma Contracting Company, and G. A. Manuel, Williams - Austin Company.

Transco Steps Up Daily Gas Deliveries

Transcontinental Gas Pipe Line Corporation has stepped up deliveries to approximately 415,000,000 cu ft a day and expects to reach maximum capacity of 505,000,000 cu ft a day early in June, President Claude A. Williams told stockholders at their annual meeting. An additional 50,000,000 cu ft of daily capacity to take care of southern customers is expected to be completed by the end of the year, Williams said.

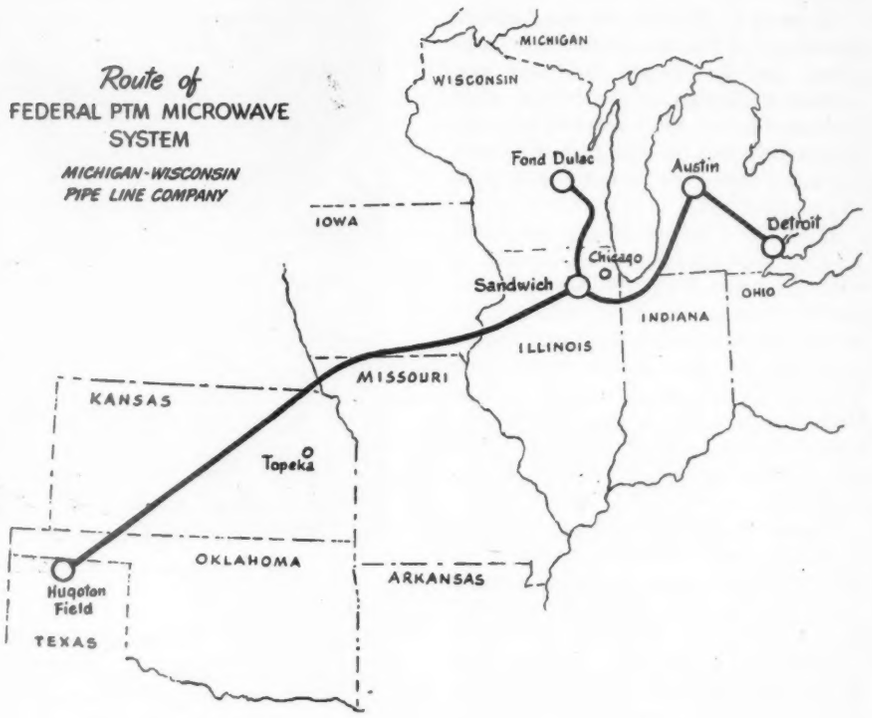
Plans for additional capacity beyond 1951 are under consideration, Williams stated, but are complicated because of steel shortage and matters of governmental defense policy.

Stockholders reelected the following directors: Clyde H. Alexander, Dallas; Alfred C. Glassell, Jr., Houston; Norman V. Kinsey, Shreveport; Benno C. Schmidt, New York and Franz Schneider, New York; Joseph J. Snyder, Boston; and Claude A. Williams, Houston.

A retirement and pension plan for officers and employees was approved by the stockholders.

Following the stockholders meeting the directors met and reelected all officers of the company.

Michigan-Wisconsin Pipe Line to Construct Microwave System



A PTM multi-channel microwave radio relay system, incorporating the latest facilities for continuous unattended telephone and other communication services, has been ordered by the Michigan-Wisconsin Pipe Line Company to serve its natural gas pipe line from Hansford County, Texas, to the Michigan-Wisconsin area. It will be one of the longest microwave systems ever used for industrial communications, covering a total distance of approximately 1500 miles.

The Michigan-Wisconsin Pipe Line Company, a subsidiary of the American Natural Gas Company, supplies the Michigan Consolidated Gas Company throughout Michigan, some 63 communities in Wisconsin and other operating utilities in Iowa, Missouri and Michigan with natural gas.

Equipment for the new system will be manufactured and installed by the Federal Telephone and Radio Corporation, Clifton, New Jersey, an associate of the International Telephone and Telegraph Corporation.

Federal's PTM (Pulse Time Modulation) microwave system is designed to provide as many as 23 voice channels, but only seven will be utilized initially in this installation, with facilities for VHF mobile radio connection, dispatching, administration, and supervisory services.

Federal's PTM system, operating at 2000 megacycles, will provide high-quality communication facilities, utilizing simple, small, high-powered RF equipment and simple multiplex equipment. Other features include common channeling units, independently operated repeater sections, and simplified repeater drop and insert equipment.

Suitable locations for the unattended microwave repeater stations now are being selected, and soon work will be initiated on the construction of microwave towers and equipment housing.

Wortham Succeeds Poe With Texas Eastern

At the annual meeting of stockholders of Texas Eastern Transmission Corporation, Gus S. Wortham of Houston, Texas, was elected a member of the board of directors to succeed the late E. Holley Poe of New York. All other members of the board were re-elected. At the meeting an amendment was approved by stockholders that will permit Texas Eastern to engage directly in operations for the development of oil and gas production and reserves. R. H. Hargrove, president of the company, reported at the meeting that average daily deliveries through the system for the first quarter of 1951 showed an increase of 30 per cent over the comparable period of 1950.

Re-elected directors of Texas Eastern are George R. Brown, Houston; R. H. Hargrove, Shreveport; Chas. I. Francis, Herman Brown, George A. Butler, William A. Smith, all of Houston; E. DeGolyer, Dallas, and Charles I. Thompson of Philadelphia.

W. G. Rogers New Head East Ohio Gas Company

William G. Rogers has been elected president of The East Ohio Gas Company, and J. French Robinson was elected chairman of the board. Rogers, an Ohioan who worked his way upward during 37 years' service with the same company, succeeded Robinson as president.

Born in Canton, Ohio, in 1893, Rogers studied civil engineering at Case Institute of Technology in Cleveland before joining East Ohio in 1914 as a beginner in the engineering department. He was in the Army from 1917 to 1919, and returned to East Ohio in 1919, becoming chief statistician two years later, and in 1925 taking over additional duties as rate engineer.

Rogers became assistant secretary in 1931, and secretary-treasurer in 1933. He was made vice president of East Ohio in 1939, and was promoted to executive vice president last year.

Robinson is a native of West Virginia and is a graduate of West Virginia University, receiving a master's degree in civil engineering in 1918, and an honorary doctor's degree was conferred upon him in 1929 by the University of Pittsburgh.

He has spent more than 30 years with the Consolidated Natural Gas Company's group of companies.

Before becoming president of East Ohio in November, 1940, Robinson served as president of The Peoples Natural Gas Company and The New York State Natural Gas Corporation, with headquarters in Pittsburgh.

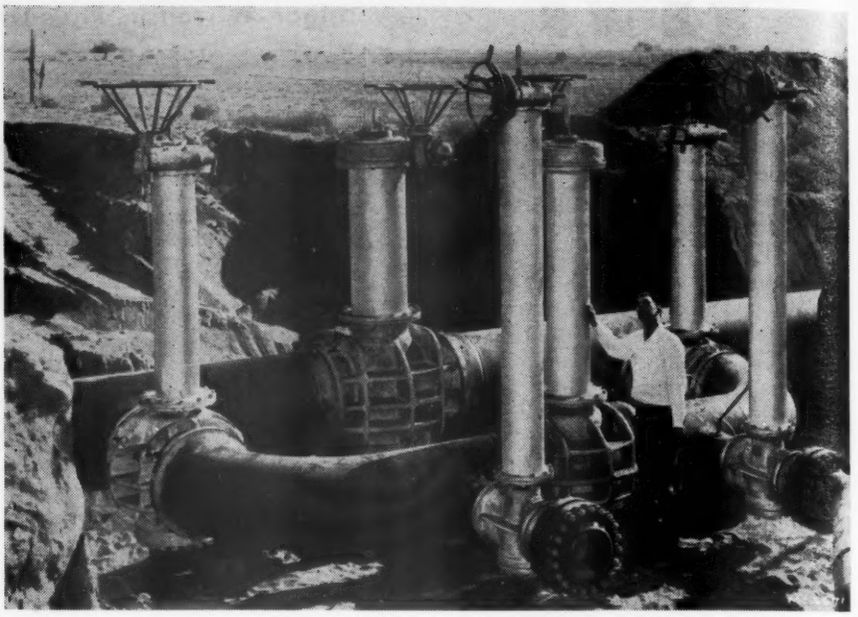
C. E. Spencer Joins the Natasco Company

Claude E. Spencer, well known in pipe line circles, has joined the Natasco Company, according to Howard L. Berkey, president.

Spencer's first job was with Sinclair Pipe Line Company. He spent 23 years with this organization, which later became Stanolind Pipe Line Company and more recently Service Pipe Line Company.

Spencer specialized in welding, tank maintenance and construction, becoming welding supervisor and tank superintendent of Service Pipe Line Company. During World War II he was loaned to the U. S. Army Engineers and was chief welding instructor for pipe line welding.

In August, 1949, he resigned from Service Pipe Line Company to accept a position as general manager of Keyes Tank Company of Casper, Wyoming. After a year he returned to Tulsa where he operated as a consultant for welding and tank service, until joining Natasco.



Pressure-limiting station near Bakersfield, California.

Underground Valve Installation on PG&E Topock-Milpitas Line

The unusual underground installation of Rockwell-built Nordstrom valves with elevated gearing, shown here, is one of seven such arrangements on the newly operating 501-mile high pressure natural gas transmission line of the Pacific Gas and Electric Company between Topock, Arizona, and Milpitas, California. This photo is of a pressure-limiting station near Bakersfield. Pipe sizes shown are 12, 24, and 34 in. The line, running through deserts, mountains, and rich farmlands will, by January 1, 1952, deliver 400,000,000 cu ft of gas a day to California.

J. L. Seger, New Head Interstate Pipe Line

Election of Joseph L. Seger as president of Interstate Oil Pipe Line Company, affiliate of Standard Oil Company (New Jersey), has been announced by Interstate's board of directors, effective July 1.

The executive vice president of Interstate, Seger succeeds Loren F. Kahle who resigned as president to assist W. R. Finney, pipe line advisor of Jersey Standard in New York, on matters pertaining to pipe line activities in domestic and foreign fields.

Seger has been acting head of Interstate since October, 1949, when Kahle was granted a leave of absence to direct construction and help draft operating plans for the Interprovincial Pipe Line Company's vast Canadian project, recently completed from Edmonton, Alberta, to Superior, Wisconsin. Kahle also will resign as executive vice president of Interprovincial, but will remain a director of Interstate.

Seger has been a resident of Tulsa since boyhood. He entered private law practice there in 1929 after graduation from the University of Illinois and Yale Law School. Four years later he joined the legal department of The Carter Oil Company, also a Jersey Standard affiliate, and in 1944 he was elected secretary.

Going with Interstate as general counsel in 1946, Seger became vice president and general counsel the following year, and executive vice president in 1949.

Kahle was reared in Oklahoma City. After receiving a degree in mechanical engineering from Iowa State College in 1924, he was employed by the Jersey Standard organization as a laborer at the refinery in Linden, New Jersey.

From 1925 to 1935, he served with the company's affiliate in Mexico where he was engaged in production engineering and pipe line construction and operations. He was transferred to the Jersey Standard Venezuelan affiliate in 1935 as chief engineer in charge of construction of pipe lines, camps, wharves, and roads. In 1941 he became superintendent of the company's terminal at Caripito.

During World War II, Kahle worked with the U. S. Navy in Panama, advising on the construction of pipe lines across the Isthmus. He moved to Tulsa in 1943 as superintendent of petroleum transportation of Carter, and a year later was chosen executive vice president of Interstate. He was elected president in 1945.

Hulton Heads Shell Transport and Supply

A. S. C. Hulton has been appointed vice president in charge of transportation and supplies for Shell Oil Company. He joined Shell Oil in 1936 in the Long Beach, California, oil

A. S. C. Hulton

fields. After handling marine transportation on the Pacific Coast for several years, he went to New York in 1941 as assistant manager of shuttle tanker operation. During World War II, he served in Washington in connection with petroleum transportation and supply matters, and since 1945 has handled similar functions for the Shell Group of companies.

Hulton replaces D. B. Hodges, on leave as director of supply and transportation for the Petroleum Administration for Defense.

Williams Bros.-Davis New Association Member

Williams Brothers-Davis Company, 6006 Jensen Drive, Houston, Texas, recently became the fortieth active member of the Pipe Line Contractors Association.

Williams Brothers-Davis Company was organized in May, 1950, and its officers and personnel formerly were associated with Williams Brothers Company of Tulsa, Oklahoma. At the present time the company is engaged in constructing 165 miles of 30-in. pipe line for Texas Eastern Transmission Corporation from Kosciusko, Mississippi to Florence, Alabama.

H. L. Davis is president of the firm; Wilbur J. Holleman, vice president; Mary J. Hailey, secretary; E. G. Thiel, treasurer and assistant secretary, J. M. Chance, office manager.

A. L. Stegner Heads PIEA; Howard Housley PESA

A. L. Stegner, of Tennessee Gas Transmission Company, Houston, Texas, was elected president of the Petroleum Industry Electrical Association, at the recent annual meeting in Dallas. H. G. Pegues, United Gas Pipe Line Company, Shreveport, Louisiana, was chosen vice president, and W. H. Massey, Interstate Oil Pipe Line Company, Shreveport, secretary-treasurer.

The Petroleum Electric Suppliers Association, which held its annual meeting at the same time, elected the following officers: Howard L. Housley, Automatic Electric Sales Corporation, Chicago, president; R. C. Stueve, Electrical Supply Company, Tulsa, Oklahoma, vice president, and H. L. Renking, Electrical Machinery Manufacturing Company, Dallas, secretary-treasurer.

The 1952 meeting of both associations will be held in Tulsa, Oklahoma.

Paine Heads Western Club

At the regular spring luncheon meeting of the Western Pipe Liners Club, held at the Lakewood Country Club in Los Angeles, R. K. Paine, manager of the Standard of California's pipe line department, was elected president for the ensuing year. J. H. Robinson of the Union Oil Company was elected vice president, and F. O. McKeany of Shell Oil Company was chosen secretary-treasurer.

These officers replace W. C. Roberts of Shell, F. E. Coyle of Tide Water, and E. B. Saunders of Standard, respectively.

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P.L. Office Managers Meet

Approximately 35 representatives of Pipe Line Contractors Association members met in Dallas, Texas, recently to discuss problems involved in the office management and accounting procedures peculiar to the pipe line construction business.

The principal speakers were Robert C. Watson, with the regional office of the National Production Authority; William J. Rogers, regional attorney for the Wage and Hour Division of the U. S. Department of Labor; J. D. Wheeler, Casualty Insurance Division, and Brad Martin, Peat, Marwick, Mitchell and Company.

Gathering System Conserves Gas During Plant Construction

More than 4 billion cu ft of natural gas ordinarily flared and wasted during construction phases of field natural gasoline plants, have been conserved and saved for commercial uses by prior installation of a high pressure gathering line. The system is operated in connection with the Scurry County, Texas, gasoline plant that is being built by 30 companies and 60 individuals.

The high pressure gas-gathering system completed and in operation since last July, some 12 months prior to scheduled completion of the plant itself, has made it possible for operators to begin conserving and selling gas at the rate of approximately 360 cu ft of high pressure gas for every barrel of oil produced. Connected to the system are 850 wells located on 3500 productive acres in the prolific Kelley-Snyder reef area where production is obtained at depths of 6500-7000 ft.

Construction of the plant itself, which is designed to process 70,000,000 cu ft of gas daily is proceeding according to schedule and will be operated by Sunray Oil Corporation under an agreement that provides for a seven-member advisory committee to represent all interests involved in the project. With operations scheduled to start in July, all compressors, scrubbers, gas coolers, fractionators, absorbers, the de-propanizer and debutanizer, etc., have been installed. Instruments and controls are now being installed in the process area. The Fluor Corporation, principal contractors, has about 250 men now working in the plant.

The Snyder plant gas-gathering facilities have a low pressure system in addition to the high pressure project, and more than 230 miles of 2-in. to 30-in. pipe serving more than 250 individual leases are involved in the two systems.

Because the gas to be handled in the low pressure system will be an extremely rich type, the drip gasoline expected to accumulate in the field system will be handled by specially designed "blow cases," which will gather the drip in low points of the system. Under pressure tied in from the high pressure system, which parallels the low pressure lines, the drip gasoline gathered in the low points of the low pressure line will be blown to the top of the next hill through a separate drip-condensate. This "stage-gathering" of the drip gasoline has eliminated considerable expense and is a unique innovation in systems of this kind. Pipe line tonnage is also much less than for a complete drip gathering net work paralleling the gas-gathering system.

Interstate To Move

Transfer of Tulsa office functions and personnel to Shreveport by Interstate Oil Pipe Line Company is now scheduled for the month of August. This is a two-month postponement of earlier plans. The delay resulted from difficulties encountered by tenants of the Shreveport office building in completing arrangements for other office space, and in obtaining necessary permits and priorities for needed repairs and remodeling.

THE PIG WITH THE POKE — CLEANS PIPE LINES

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Williamson Pipe Line Pigs*

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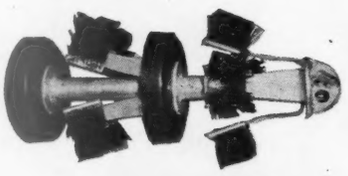
NATURAL GAS PIPE LINES

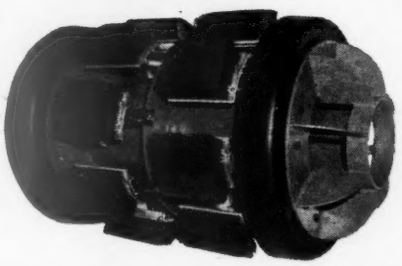
4" Size—TYPE JRN—2" to 4" sizes will pass 1½ R-90° Bends. No valves other than full diameter thru port valves.

Use TYPE SCN-51 for 6" size.



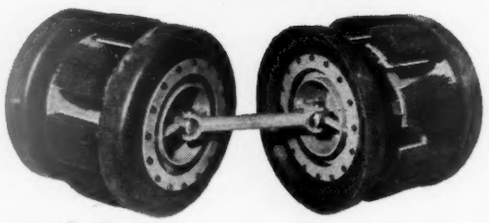
8" Size—TYPE WC-11—8" to 14" will traverse 6 foot radius field bends, full diameter side openings at 45°.

SPRINGS COMPENSATE for BRUSH WEAR.



20" Size—TYPE GP-2—16" to 30" 200 lb. SPRING forces the brushes against pipe wall—COMPENSATING for WEAR. Will traverse round opening gate or plug valves.

SPRINGS and BRUSHES are identical and interchangeable for all types and sizes of GP-PIGS.



24" Size—GP-3—18" to 30" sizes will pass 1½ R-30° bends. SPRINGS COMPENSATE for BRUSH WEAR ASSURING full section cleaning efficiency. GP-3 consists of two Type GP-1 Pigs. Each unit may be used as individual pig.

*Patents Pending

T. D. Williamson, Inc.

TULSA 9, OKLAHOMA

Tennessee Gas Expands Gas Supply Department

The Gas Supply Department of Tennessee Gas Transmission Company has been expanded by the acquisition of three veteran technicians in the oil and gas industry, Ralph C. Graham, vice president of the company, announces.

R. M. Beatty, administrative assistant, formerly was chief geologist of the American Republics Corporation. A graduate of Lafayette College, Easton, Pennsylvania, and World War II veteran, he has been connected with the Pure Oil Company, and with the Tidewater Associated Oil Company.

Ralph Coleman, production superintendent, previously was assistant general manager of the Mexican American Independent Company in Mexico City and earlier was connected with the Gulf Oil Corporation. A University of Texas graduate and World War II veteran, he was assigned to an oil exploration project in Alaska both as a Navy officer during the war and later as chief engineer and drilling superintendent of Arctic Contractors, which took the project over from the Navy.

Stewart Barclay, chief geophysicist, joins Tennessee Gas from the Mexican American Independent Company, Mexico City, where he was chief geologist. A graduate of Louisiana State University, he joined the geophysical division of Phillips Petroleum Company and later for several years was chief geophysicist in Venezuela.

Tennessee Gas Transmission Company now buys gas in 113 fields in Texas and Louisiana, and the proper correlation of these reserves and the dispatching of gas therefrom has necessitated increasing its personnel to properly handle these problems.

No Affiliation

Harold C. Price, president of H. C. Price Company, of Bartlesville, Oklahoma, has issued the following statement:

An announcement recently appearing in a number of industrial publications states that a newly organized pipe line contracting firm "is in effect a merger of the talents and key personnel" of H. C. Price Company and another contracting company. This tends to give the impression that H. C. Price Company is affiliated with the new organization. We wish to definitely state that neither H. C. Price Company or any of its personnel has any connection whatsoever with this new company and it is to correct any such misconceptions that this statement is being issued.

MidSouth Seeks to Acquire Arkansas Line

MidSouth Gas Company, Little Rock, Arkansas, has filed an application with the Federal Power Commission proposing to acquire a 38-mile natural gas pipe line now being constructed in Arkansas by Arkansas Power and Light Company, of Pine Bluff, Arkansas.

MidSouth would pay $900,000 for the 12¾-in. line. The line will extend from a connection with the facilities of Texas Gas Transmission Corporation near Helena, Arkansas, to Arkansas Power's Hamilton Moses steam electric generating station near Palestine, Arkansas.

Foster Promoted

John D. Foster, of the Service Pipe Line Company engineering department, has been promoted to area engineer for the company's Illinois and Missouri divisions, J. R. Polston, Tulsa, vice president-operations, has announced. Foster will reside in Galesburg, Illinois. He received a bachelor of science degree in petroleum engineering at Tulsa University. A World War II naval aviator, he received a master's degree in aeronautical engineering at the California Institute of Technology.

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Shown above is part of a 270-mile pipe line, from Yale, Oklahoma to Borger, Texas, protected by Nicolet Asbestos Pipe Line Felt. Note the continuous, even application without breaks.

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PIPELINE PERSONALS

▸ **C. R. "Dick" Williams,** long associated with the oil and gas industry, resigned an executive position with the Chicago Corporation earlier this year to become president of the Pacific Northwest Pipeline Corporation and vice president of the Fish Gas and Oil Corporation, Houston, Texas.

Williams was born at Double Circle Ranch, Texas County, Oklahoma, November 5, 1907. He received an AA degree in chemistry in 1927 from Oklahoma Junior College, a BS in chemical engineering from the University of Oklahoma in 1930, and studied gas technology at Johns Hopkins University in 1932-33.

C. R. "Dick" Williams

After graduating from the University of Oklahoma in 1930 he joined the Continental Oil Company of Ponca City, Oklahoma, in the capacity of control chemist. When he left the Continental Oil Company in 1942 he held the title of general manager, Oil and Gas Division.

He joined the Chicago Corporation in 1942 as vice president in charge of operations, making his headquarters in Corpus Christi, Texas. In 1945 he became an executive officer of Chicago Corporation subsidiaries, vice president of Gulf Plains Corporation and Triangle Pipe Line Company, and president of the Stratton Pipe Line Company.

Williams is a member of the American Petroleum Institute, National Petroleum Council, Natural Gasoline Association of America, and Alpha Chi Sigma.

He married Stella Disney April 25, 1931, and they have two sons, Charles Richard and Robert Lee.

▸ **E. C. Mishou,** division engineer at Shreveport, Louisiana, for Interstate Oil Pipe Line Company, was transferred to New York the middle of May to begin a year's special assignment in the office of the pipe line advisor, Standard Oil Company (N.J.). Mishou was first employed by Ajax Pipe Line Corporation as an engineer in 1943 and resigned to accept a post with Interstate in 1945. For two years he served as safety engineer with headquarters in Tulsa. In October, 1948, he was named division engineer.

Wayne Corley, who was transferred from Shreveport to Tulsa in 1949, returns to Shreveport as division engineer of the Southern Division.

N. E. Tilden, head of the design unit of the engineering department, Tulsa, recently assumed additional duties as acting chief engineer.

▸ **Herbert E. Fisher** of Chicago has been appointed supervisor of planning for Service Pipe Line Company, according to *T. R. Aude,* director of planning and economics.

Fisher attended University of Oklahoma, Norman, and joined Service Pipe Line in 1932 as a laborer. He advanced through various positions in the company's engineering department until 1942 when he joined Standard Oil Company (Ind.), Chicago. Until May 1, Fisher was chief engineer of Standard's products pipe line department.

Albert S. Munneke has been made superintendent of Service Pipe Line Company's Salt Creek district in Wyoming. He will reside in Casper. Munneke started with Service Pipe Line in 1940 as a lineman. He was Oklahoma division area engineer. He replaces **S. L. Cox** who has accepted a position with the products pipe line department of Standard Oil Company (Ind.).

C. F. Gearhart, Jr., area engineer of Service Pipe Line Company's Wyoming division, also has accepted a position with Standard of Indiana's products pipe line department. **John H. Keyes, Jr.,** was promoted from oil traffic engineer to replace Gearhart, and **Morrison Hynd,** an engineer in the Casper office was promoted to oil traffic engineer.

William C. Cooper, another engineer in the Casper office, was transferred to Service Pipe Line's Missouri division with headquarters in Carrollton. **Ellston H. Brewer,** Shawnee, has been named area engineer for Oklahoma, replacing Munneke.

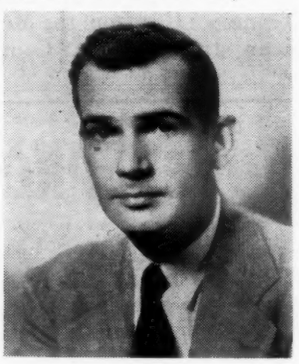
▸ **Maurice E. Bless** has been promoted to district supervisor, land and lease, by the Texas Gas Transmission Corporation. He will make his headquarters in Memphis, Tennessee. He has been associated with the company as a soil conservationist.

Martin Ray Moore was recently appointed division soil conservationist with headquarters in Memphis.

Robert C. Courtney has been made senior safety engineer. He has been a safety engineer with the U.S. Bureau of Mines in Dallas, Texas.

W. B. Threlkeld is now assistant to **John W. Polkinghorn,** director, land and lease. He has been chief clerk and assistant superintendent, Division 1, Pipe Line Department.

B. E. Reynolds has been promoted to assistant to the division superintendent — compressor stations. He also has been named manager of the Terre Haute compressor station. In addition to his duties as station manager, he will assume assignments in connection with the Oaktown and Niagara stations and the station being constructed at the new Alford underground storage field. He was formerly manager of the company's stations at Slaughters and Calvert City.



Leon M. Sipes

▸ **Leon M. Sipes** has been appointed editor of publications for Texas Eastern Transmisison Corporation, **Jack Clarke,** director of public relations, announces.

Sipes, formerly general manager of Radio Enterprises, Inc., of El Dorado, Arkansas, has been actively engaged in radio and editorial work since 1932, and has served as manager of Radio Station KELD since 1943. Prior to that time, as assistant advertising manager for an oil company, he edited an industrial publication. He is past president of the Arkansas Associated Press Broadcasters Association and a member of the board of directors of the Arkansas Broadcasters Association.

Sipes was born in Lewisville, Arkansas, in 1911. He is a graduate of Little Rock High School and attended Hendrix College, Conway, Arkansas, and Ouachita College of Arkadelphia, Arkansas.

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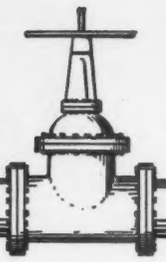
PIPE LINE PROJECTS



Kansas-Nebraska Would Construct New Lines

Kansas-Nebraska Natural Gas Company, Inc., Phillipsburg, Kansas, has applied to the Federal Power Commission for authority to construct additional pipe line facilities in Nebraska and Colorado to increase the capacity of its natural gas transmission system from the presently authorized 164,200,000 cu ft per day to 182,600,000 cu ft daily.

The proposed construction program includes a 15-mile, 6⅝-in. pipe line and 11 miles of 8⅝-in. pipe line from the Big Springs field in Deuel County, Nebraska, to Ogallala, Nebraska; 2 miles of 2⅜-in. lateral lines and two town border stations to serve Big Springs and Brule; 8 miles of 8⅝-in. line and 5 miles of 4½-in. line from the Big Springs field to Ovid; 13.5 miles of 2⅜-in. laterals and 10.5 miles of 3½-in. laterals and four town border stations to serve Chappell, Lodge Pole, Ovid, and Julesburg; a 52-mile, 8⅝-in. line to replace the existing 4½-in. Ogallala-North Platte, Nebraska, line; and necessary lateral lines and regulating equipment to serve the four industrial customers.

Service to Build New Lines to Texas Areas

Pipe line outlet for the increasing oil production in Stonewall, Haskell, and Knox counties, Texas, will be available with completion of a new system to be built by Service Pipe Line Company.

Gathering systems will connect production in the Old Glory, Kiowa Peak, and North Aspermont fields of Stonewall County, in South Haskell field of Haskell County, and in North Knox City field of Knox County, J. L. Burke, president of Service Pipe Line Company, announces.

A 135-mile line of 8- and 10-in. pipe will be built from the vicinity of the Old Glory field to Service's present system at Bowie, Texas.

"Although the new line is being built to serve new development in the Stonewall-Haskell area, the line to Bowie will traverse an area where active exploration is under way," Burke said. "We are confident that this area has a bright future."

In describing plans for the new artery Burke said, "This is another step in our program to provide pipe line service for West Central Texas producers. Our first line from West Central Texas north was built in 1919, but we have not been a major gatherer in the area since the days of Ranger flush production. In 1951, we have reentered this increasingly important area."

Service early in April began gathering oil produced from 1633 wells on 320 leases in Throckmorton, Shackleford, Stephens, and Haskell counties.

Survey parties are staking out routes for the sections of this program to be laid first. Construction will begin as soon as pipe and equipment can be moved in.

"The pipe for this project is available," said Burke.

Standby Gas Storage Asked for Maryland

Washington Gas Light Company, Washington, D. C., has applied to the Federal Power Commission for authority to construct and operate a standby gas storage plant near Rockville, Maryland.

The proposed plant would have a delivery capacity of 100,000,000 cu ft of gas, consisting of 70,000,000 cu ft of natural gas stored under pressure in underground steel pipes and 30,000,000 cu ft of propane-air gas. Estimated cost of constructing the plant is approximately $7,100,000, including the cost of land.

The proposed plant would supplement the company's present standby facilities in the event of failure of its supply of natural gas from Atlantic Seaboard Corporation. The existing standby facilities, the application continues, are wholly inadequate, having a delivery capacity under emergency conditions of about 50,000,000 cu ft a day for the first day of any emergency. Under present circumstances, if a pipe line failure occurred, the company said, that amount would last only a few hours on a peak day.

The company plans to start the construction in July of this year and to complete the job during the spring of 1952; however, the application says, it is expected that part of the storage facilities will be available for use on January 1, 1952.

United Gas Granted Temporary Authorization

The Federal Power Commission has granted temporary authorization to United Gas Pipe Line Company, Shreveport, Louisiana, for the construction of approximately 50 miles of pipe line in the southeastern Alabama and northwestern Florida area.

The construction program includes about 39 miles of 16-in. loop line paralleling United's existing Pensacola lateral from a point in Baldwin County, Alabama, southeasterly to a point in Escambia County, Florida; and two laterals, one about 5.8 miles long paralleling United's existing Gulf Power Company lateral in Escambia County, and the other, 5 miles long, extending to Saufley Field.

United also will install tap and sales meter stations to serve Saufley Field, Eglin Air Force Base, and the Florida towns of Fort Walton, Niceville, Valpariso, Crestview, and De Funiak Springs.

The construction, estimated to cost $1,945,000, will bring the total capacity of United's Pensacola pipe line facilities up to about 75,700,000 cu ft a day.

Gas Line and Compressor Units for Pennsylvania

Pennsylvania Gas Company, Warren, Pennsylvania, has received Federal Power Commission authorization for the construction of 52 miles of natural gas pipe line and five new compressor units on its system in Pennsylvania.

The new 12¾-in. line will parallel existing transmission lines between Warren and Erie. The line will be used during the winter to augment the supply of natural gas to Corry and Erie, and during the summer months to transport gas to the company's storage areas.

Three additional gas compressor units totaling 990 hp will be installed at the company's Roystone compressing station in Warren County, Pennsylvania, and two additional units totaling 440 hp will be installed at the Sackett compressing station in Elk County, Pennsylvania.

Estimated overall capital cost of the facilities is approximately $2,200,000.

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More Work Planned By Colorado Interstate

Colorado Interstate Gas Company, Colorado Springs, has applied to the Federal Power Commission for authority to build facilities designed to increase the capacity of its recently authorized 216-mile natural gas pipe line extending from the West Panhandle gas field in Texas to a point in Cheyenne County, Colorado.

The company plans to engage in a two-year construction program, estimated to cost $3,453,105, to enable it to meet the anticipated needs of its resale customers in the Rocky Mountain market area.

The company is proposing during 1951 to increase the horsepower of its new Panhandle field compressor station from the presently authorized 4800 hp to 6600 hp and to install an additional 1320 hp unit at its Kit Carson, Colorado, compressor station. Colorado also plans during 1951 to build 30 miles of 20-in. loop line extending from a point in Elbert County, Colorado, to the Limon, Colorado, area, and to construct 19 miles of 6⅝-in. lateral connecting line in the Fort Lynn, Colorado, area connecting the company's existing system with the authorized 216-mile line.

During 1952, Colorado plans to install two additional 1320-hp units at the Panhandle field station; to install one additional 1320-hp unit at the Kit Carson station to bring the total horsepower there to 11,040; and to build 18 miles of 20-in. loop line on its Kit Carson-to-Denver pipe line.

FPC Allows Rehearing in Part On Lake Shore Order

The Federal Power Commission has granted in part two requests for rehearing of its February 15 order authorizing Lake Shore Pipe Line Company, Cleveland, Ohio, to acquire, construct and operate pipe line facilities to supply the northeastern Ohio area with natural gas.

No date was set for the rehearing, which will be concerned with a 27-mile section of old pipe line, extending from Ashtabula to Fairport, which Lake Shore plans to operate as part of its system.

The rehearing was requested by Erie Gas Service Company, Inc., of Oil City, Pennsylvania, and Grand River Gas Transmission Company, of Cleveland, which were competing with Lake Shore for the northeastern Ohio market and whose applications were denied by the FPC's February 15 order.

The FPC's February 15 order was conditioned to require that the section of 27-year-old pipe line be further tested and that the results of the test be presented to the commission before the authorization became effective. The commission also said that if any new estimates of construction costs, rate base and cost of service result from the test, they must be submitted also.

The rehearing will be held on these issues and also on whether the line is adequate to render the service proposed, and whether the public convenience and necessity require the acquisition, construction and operation proposed by Lake Shore or the construction, and operation proposed by Grand River and Erie in the event the results of the tests on the old pipe show that Lake Shore's construction costs, rate base or cost of service will be higher than previously estimated.

Valley Gas Pipe Line Project Appears Dropped

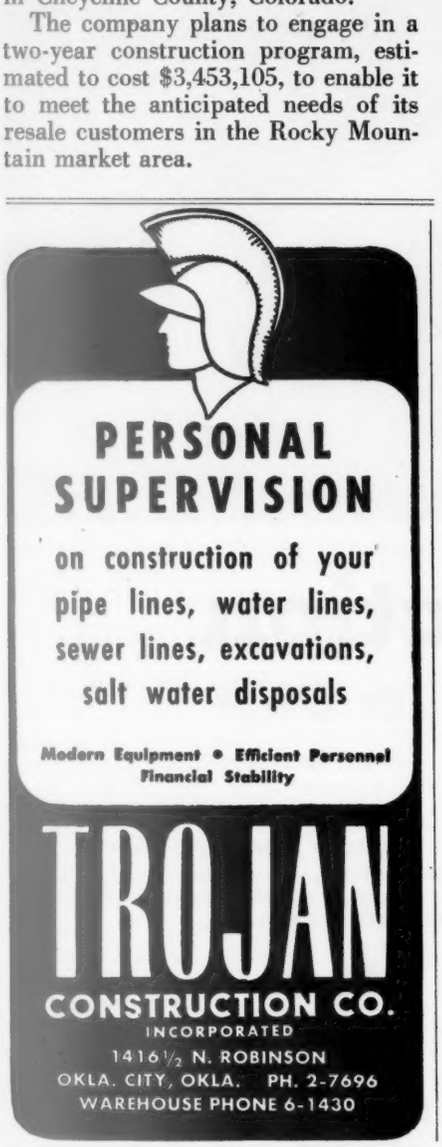
The Federal Power Commission has dismissed without prejudice, for lack of prosecution, the application of Valley Gas Pipe Line Company, Inc., proposing the construction of a $144,500,000 pipe line project to carry natural gas from Texas and Louisiana to markets in Indiana, Ohio, and Michigan.

The application, filed in June 1950, indicated that additional information would be submitted and that construction of the project would commence by the end of 1950. The commission said that Valley failed to file any additional information in support of its application and did not seek a hearing prior to December 31, 1950.

The commission said that on February 6 of this year Valley was requested to advise the FPC as to the date it proposed to file the exhibits required by the commissions rules of practice and procedure, and the date it would be able to begin formal hearings.

Valley, by letter dated February 21, requested that action on its application be held in abeyance for 30 days beyond February 23. The commission granted an extension, contingent on the filing of the exhibits by March 31. Valley then subsequently sought, and was granted, a further extension until April 25, but to date has failed to file the exhibits.

Valley's proposed project would include a 1000-mile line extending from Hardin County, Texas, across Louisiana, Arkansas, Missouri, Illinois, Indiana, and into southern Michigan. In addition, the company proposed to build 500 miles of line in Louisiana and Texas together with necessary laterals for supply and distribution.



Pan Am Pipe Line to Build East Texas System

Pan American Pipe Line Company of Houston will build additional pipe line outlets for increasing production in Wood County, Ira O. Walker, company president, states.

Ten and one-half miles of gathering system consisting of 4-, 6-, and 8-in. pipe will be laid in the Forest Hills and Midway Lake oil fields in Wood County between Winnsboro and Quitman. The system will gather approximately 1200 bbl of oil daily. Contract for the construction of the gathering system has been awarded to the Joe Titsworth Construction Company of Kilgore.

In addition, the company will loop its present Quitman-Hawkins trunk line with 10 miles of 8-in. pipe to increase the capacity of this line from 13,500 to 17,500 bbl a day. Contract for the Quitman-Hawkins loop-line has been awarded to the Gregg Construction Company of Longview.

Southern Natural Proposes Another Capacity Increase

Southern Natural Gas Company, Birmingham, Alabama, has asked the Federal Power Commission for authority to construct pipe line facilities that would increase the daily delivery capacity of its natural gas transmission system from 555,000,000 cu ft to 670,000,000 cu ft.

The proposed new facilities, estimated to cost $13,641,000, would be in Alabama, Georgia, Mississippi, and Louisiana, and would include three compressor stations with a total of 19,450 hp and approximately 169 miles of various size pipe lines.

The proposed new compressor stations would be in Jefferson Davis and Clarke counties, Mississippi, and Hale County, Alabama. The pipe line construction includes a 20-mile supply line in Ouachita Parish, Louisiana; 33 miles of triple loop line in Ouachita and West Carroll parishes, Louisiana; 7 miles of tripe loop line in Sharkey County, Mississippi; and 108 miles of 14-in. line extending through Georgia from Bass Junction to Augusta. The delivery capacity of the latter line would be 53,000,000 cu ft a day, the application states.

This proposal represents in part a modification of the application previously authorized in Docket No. G-1308, including, among other changes, substitution of a 14-in. pipe line in place of the previously authorized 108 miles of 10¾-in. pipe line from Bass Junction to Augusta, Georgia.

Application for Florida Gas Line Is Dismissed

The Federal Power Commission has dismissed the application of South Atlantic Pipe Lines, Inc., of Jacksonville, Fla., for authority to construct a 254-mile natural gas transmission line in Florida from the Jacksonville area to St. Petersburg.

The company had proposed to connect with other natural gas transmission lines in the vicinity of Jacksonville for its supply of natural gas, but the commission pointed out that there is at present no natural gas line in that area, and none has been authorized by the FPC. In the absence of a definite source of natural gas, the FPC said, the company is unable to supply, in support of its application, the information, data, and exhibits required by the commission's general rules and regulations.

South Atlantic's proposed project was to have included, in addition to the 254-mile line, about 50 miles of laterals, a compressor station and necessary metering, regulating and other appurtenant facilities. Estimated cost of the construction was $23,500,000.

Shell to Build Line To Gohlke Field, Texas

T. E. Swigart, president of Shell Pipe Line Corporation, announces plans to lay an 8-in. crude oil pipe line to give an outlet to Gohlke field, De Witt County, Texas, and other fields in the immediate area by connecting them with Shell Oil Company's refinery at Houston.

Active development is proceeding in the general area, with current production totaling about 2000 bbl a day.

El Paso Natural Sells Facilities to Subsidiary

The Federal Power Commission has authorized El Paso Natural Gas Company to sell natural gas facilities in the El Paso, Texas, area to its wholly owned subsidiary, El Paso Gas Transportation Corporation.

The facilities include approximately 32,187 ft of pipe, 2,493 ft of which is to be constructed; a city gate station; and regulating and measuring equipment. Estimated net book cost of the facilities was $112,462 as of December 31, 1949.

The El Paso city limits recently were extended to include the area in which the facilities are situated, and since El Paso Natural Gas Company does not have a franchise to do business within the city, the acquisition by the subsidiary was necessary.

Cities Service Buys Lines

Cities Service Pipe Line Company announces the purchase of the Comanche pipe line properties in Pecos County, Texas. This pipe line system has been operated by W. H. Waldrop of Monahans, Texas, for many years as Comanche Pipe Line.

The system serves the Santa Rosa, Orient, and Pecos Valley pools. The oil will be delivered to Texas-New Mexico Pipe Line Company's Lehn-Apco junction for Cities Service.

Daniel Meter Tubes Shipped. A partial shipment of Daniel Orifice meter tubes starts its long journey by truck from Houston—destination, Pennsylvania. This is the first lot of an order for more than 60 of these precision fabricated meter tubes to be shipped from the recently expanded Daniel plant in Houston.

With the PIPE LINE CONTRACTORS

Mahoney Contracting Company, 2300 North Grand River, Lansing, Michigan, is making progress on the 100 miles of 26-in. being laid for Trunkline Gas Supply Company between Flora and Joppa, Illinois. Two spreads are now at work. One is making its headquarters at Flora. Barney Finnerty is superintendent and Frank Pavelka office manager. The second spread is working out of Marion, Illinois, with Henry Mogg superintendent and Joe Cuthbert office manager.

As soon as the Trunkline job is completed, work will begin on 36 miles of 20-in. for Texas Eastern Transmission Corporation from Connelsville, Pennsylvania, and the Oakford storage area. Henry Mogg will be in charge and the field office will be at Greensburg, Pennsylvania.

Harold Finnerty is general superintendent for Mahoney.

The company also has contracted to install two water crossings in Venezuela for Shell Caribbean Petroleum Corporation. One is a 10-mile, 20-in. crossing of Lake Maracaibo, the other a 4-mile, 30-in. crossing of the Gulf of Coro. Angelo Tavernaro will be in charge.

O. R. Burden Construction Company, P. O. Box 5216, Tulsa, Oklahoma, has opened an office at Moberly, Missouri, from which point right-of-way and road crossing work is being done on the Platte Pipe Line Company job. No pipe has been received and may not be for 30 to 60 days, according to latest reports. The section to be laid for Platte consists of 280 miles between the Missouri River, near St. Joseph, Missouri, and the Mississippi River, near Wood River, Illinois.

Pete Hiner is in charge of the spread working out of Mt. Carmel, Illinois, on the 56.6 miles of 10¾-in. pipe being laid for The Texas Pipe Line Company from Lawrenceville, Illinois, to Mount Vernon, Indiana. Mrs. J. G. Coons is in charge of the office.

Williams Brothers Company, National Bank of Tulsa Building, Tulsa, Oklahoma, now has four spreads in the field on the Plantation Pipe Line Company job. The latest spread went into action out of Prentiss, Mississippi. O. R. Mitchell is the superintendent and R. J. Purdy office manager. This gang is laying 127 miles of 18-in. between Collins, Mississippi, and Baton Rouge, Louisiana. The other spreads are making their headquarters as follows:

Carrollton, Georgia, T. E. Davis superintendent and J. E. G. Jester office manager.

Bessemer, Alabama, O. L. "Whitey" Martin superintendent and R. G. Conley office manager.

Eutaw, Alabama, A. T. Maxwell superintendent and Joe Breedlove office manager.

The central project office is at Tuscaloosa, Alabama, and George Allen is general superintendent.

In Venezuela, 195 miles of 10, 12, and 16-in. pipe are being laid for the Venezuelan Atlantic Transmission Corporation from Las Mercedes to Caracas. Marvin E. Jones, superintendent, has his headquarters in Caracas.

Jones also is supervising the laying of 160 miles of 30-in. from Palmerejo, near Maracaibo, to Punta Cardon, Venezuela, for Shell Caribbean Petroleum Company.

Associated Pipe Line Contractors, Inc., P. O. Box 2163, Houston, Texas, has contracted to lay approximately 100 miles of 20, 24, 26, and 30-in. pipe near New Orleans, Louisiana, for J. Ray McDermott & Co., Inc., one of the Gulf Southern group that is laying 1000 miles of line for United Gas Pipe Line Company. Associated has opened a field office at Franklin, Louisiana, where L. H. Gray is superintendent and James Luther and Ralph Herwig are in charge of the office work.

A contract also has been made with the U. S. Army Corps of Engineers to lay 188 miles of 6⅝-in. pipe line from Searsport to Limestone, Maine. Cecil Rogers is superintendent and A. B. Johnson manager of the field office, which is at Bangor, Maine.

Britton Contracting Company, 93 South Main Street, Washington, Pennsylvania, is constructing 116 miles of 16-in. pipe line for Northeastern Gas Transmission Company, between Springfield, Massachusetts, and Greenwich, Connecticut. Central headquarters are in Springfield, Massachusetts. Herb Britton is general superintendent. Two spreads are being worked. One is making its headquarters at Plainville, Connecticut, where Johnny Waldron is spreadman and Charles Quinn office manager. The other spread is under the supervision of "Curley" Hahn.

Bechtel Corporation, 220 Bush Street, San Francisco, California, began work in March on a pipe line for General Petroleum Corporation between San Ardo and Estero Bay, California, consisting of 42 miles of 8-in. crude oil line and 42 miles of 4-in. to be used for cutter stock. The project office is at Watson and the field office at San Miguel. J. S. Connell is general manager and George Anderson project manager.

After being held in abeyance awaiting open weather, work is again proceeding on the 409 miles of 30-in. for Texas Illinois Natural Gas Pipeline Company in Arkansas and Missouri. The project office is at 409 East Markham Street, Little Rock, Arkansas. E. W. Davis is division manager, E. J. Hayes division office manager, and E. C. Elting project office manager.

Spread offices are as follows:

Newport, Arkansas, general delivery—B. C. McLean, office man.

Bald Knob, Arkansas general delivery—Virgil Cobb, superintendent; C. A. Bingaman, office man.

Hope, Arkansas, general delivery—V. L. Williams, superintendent; Harry Sager, office man.

Arkansas River crossing, Box 349, North Little Rock, Arkansas—George Wahlgren, superintendent.

Jackson, Missouri, general delivery—J. E. Richardson, superintendent; E. C. Gavagan, office man.

Bechtel Constructors, Inc., 220 Bush Street, San Francisco, California, began work the middle of April on 120 miles of 24-in. for the Tennessee Gas Transmission Company, between Hamburg, New York, and the Hudson River. The project office is at Richfield Springs, New York, P. O. Box 789. R. L. Bowman is general superintendent, G. H. Homann administrative manager, and W. H. Molander, office manager.

Rumsey Brothers Pipe Line Construction Company, M. and M. Building, Houston, Texas, is waiting on pipe to begin construction of 100 miles of the Platte Pipe Line Company system, the section from the Nebraska-Kansas state line, near Lanham, Kansas, to the Missouri River, near Doniphan, Missouri. Al Works will be the superintendent and Walter A. Hale office manager.

This contractor is laying 52 miles of 24 and 26-in. for Panhandle Eastern Pipe Line Company in Kansas.

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BARAWATE concrete is readily applied either mechanically or pneumatically over the reinforcing steel, or may be pre-cast for river clamps. BARAWATE is chemically inert, reducing the corrosion problem and protecting the softer inner coatings against attack by barnacles or other destructive marine organisms.

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Chemically inert—reduces corrosion problem.

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Easy to apply.

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Available either in bulk or in 100 lb. sacks

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BAROID SALES DIVISION
NATIONAL LEAD COMPANY

▸ **H. C. Price Company,** pipe line division, Box 1111, Bartlesville, Oklahoma, has the general contract covering construction of approximately 156 miles of 24-in. high pressure natural gas pipe line for Tennessee Gas Transmission Company between Hamburg, New York, and the Onondaga-Madison county line, New York. Spreads are located as follows:

Auburn, New York, Box 657, Telephone 24591: G. A. Reutzel, superintendent; W. E. Yount, office manager; and the following foremen: J. A. Hairston, right-of-way; L. J. Loncarich, ditch; J. C. Anderson, bending; H. C. Morrison, pipe; K. N. Adkins, pipe; R. W. Orr, welding; S. J. Wood, coating; A. L. Bell, lower-in; T. E. Walker, clean-up; J. H. Ingram, Sr., chief mechanic.

Warsaw, New York, Box 214, Telephone 618: R. K. Shivel, superintendent; W. R. Crego, office manager; and the following foremen: J. D. White, right-of-way; W. H. Olrich, ditch; J. H. Latham, bending; Delbert Shivel, pipe; R. L. Ezell, welding; Sam Price, clean-up; C. W. Sisco, lower-in; J. B. Northcutt, coating; Tommie Stammer, chief mechanic; Cleo Robertson, road crossing.

Also a general contract covering construction of approximately 200 miles of 30-in. high pressure natural gas pipe line for Texas Illinois Natural Gas Pipeline Company from the Trinity River northeastward to the Texas-Arkansas state line near Texarkana. Spreads are located as follows:

Carthage, Texas, General Delivery, Telephone 1178: C. E. Shivel, superintendent; D. H. Johnston, office manager; and these foremen: R. H. Edwards and Paul McCormack, right-of-way; Ray Drewell, ditch; J. V. Huff, bending; E. D. Worley, pipe; C. F. Jones, welding; Henry Hill, coating; Bill Buchanan, lower-in; Boyd Danner, chief mechanic.

Nacogdoches, Texas, Box 906, Telephone 2198: C. R. Ice, superintendent; G. A. Harvey, office manager; and the following foremen: John E. Hamilton and Jessie Cash, right-of-way; E. W. Whisenant, ditch; Forest Loinette, bending; W. T. Dickerson, pipe; L. O. Reutzel, welding; N. D. Adams, coating; J. C. Rich, lower-in; Cliff Birmingham, chief mechanic.

▸ **H. C. Price Company,** somastic division, Bartlesville, Oklahoma, announces the following jobs:

Philadelphia plant operations:

Allentown-Bethlehem Gas Company —Application of Somastic coating to 14,500 ft of 12¾-in. OD pipe.

Consolidated Edison Company — Application of Somastic coating and internal cleaning and coating to approximately 13,400 ft of 8⅝-in. OD pipe.

Okonite-Callender Cable Company, Inc.—Application of coating and internal cleaning and coating to 31,100 ft of 6⅝-in. OD pipe; 25,700 feet of $5\frac{9}{16}$-in. OD pipe.

Phelps-Dodge Corporation—Application of coating and internal cleaning and coating to 11,000 ft of $5\frac{9}{16}$-in. OD pipe.

Philadelphia Electric Company—Application of coating to 500 ft of 20-in. OD pipe; 80,000 ft of 16-in. OD pipe.

Philadelphia Gas Works Company —Application of Somastic coating to all pipe requirements from 1¼-in. to 30-in. for 1951.

At Staten Island, New York:

Transcontinental Gas Pipe Line Corporation—Application of Somastic coating to 71,000 ft of 26-in. OD pipe; 16,000 ft of 24-in. OD pipe and application of 3-in. Hevicote to 16,000 ft of 24-in. OD pipe.

New Orleans Plant Operations At Morgan City, Louisiana: Gulf Southern Contractors (for United Gas Pipe Line Company)—Application of Somastic coating to approximately 26.3 miles of 30-in. OD pipe; 23.8 miles of 26-in. OD pipe; 24.6 miles of 24-in. OD pipe; 15.5 miles of 20½-in. OD pipe; 21.1 miles of 20-in. OD pipe; 13.4 miles of 16-in. OD pipe, and 12.3 miles of 14-in. OD pipe.

▸ **Oklahoma Contracting Company,** 1210 Mercantile Bank Building, Dallas, Texas, has begun laying pipe on the New England system of Tennessee Gas Transmission Company and its subsidiary, Northeastern Gas Transmission Company. The contract calls for construction of 175 miles of line from the Hudson River just south of Albany, New York, to a point near Wilmington, Massachusetts. Central headquarters are at Springfield, Massachusetts, with Paul R. Halbert in charge and Harry Prindle his assistant. Headquarters for three spreads have been established. At Pittsfield, Massachusetts, H. A. "Red" Wylie is the superintendent; at Westfield, Massachusetts, Aldress Kilgore, and at Sudberry, Massachusetts, L. B. Rea.

The 65 miles of 26 and 30-in. loops for Tennessee Gas near Falfurrias and Victoria, Texas, have been completed.

▸ **J. Ray McDermott and Company,** New Orleans, Louisiana, a member of the Gulf Southern Contractors group, have begun work on the marine portion of the job that is being done for United Gas Pipe Line Company. From the Louisiana coast, 28 miles of pipe will be laid out into the Gulf of Mexico.

▸ **Midwestern Constructors, Inc.,** 105 North Boulder, Tulsa 3, Oklahoma, has released the following progress report as of May 15:

Schedule 11 for Texas Illinois Natural Gas Pipeline Company is 42 per cent completed. This schedule consists of 100 miles of 30-in. from the Mississippi River near Chester, Illinois, to Effingham, Illinois. Field headquarters are at DuQuoin and Carlyle. Everett Hart is superintendent at the former place; John Work at the latter.

Schedule 12 is 100 miles of 30-in. from Effingham to Sibley, Illinois. The field office is at Monticello where Cliff Simmons is superintendent.

Schedule 13, consisting of 92 miles from Sibley to Joliet, is 12 per cent completed. Denver Franklin is superintendent and the field office is at Morris, Illinois.

Work was scheduled to begin June 1 on the Mississippi River crossing near Wittenberg, Missouri, and a field office has been established at that point. Three separate 20-in. lines will be laid. Howard S. Lipp is coordinator, Clyde Peters superintendent in charge of pipe, and Ivan Steele office manager.

The central office for this work is at Decatur. M. T. "Bill" Wilhite is general superintendent, and A. T. Tolbert is in charge of the office.

This is the status of the work being done for Panhandle Eastern Pipe Line Company involving station additions and piping at three stations:

The work at Tuscola, Illinois, is 30 per cent completed. F. C. Snavely is superintendent and Morris D. Carey office manager.

At Zionsville, Indiana, the job is 25 per cent completed. J. A. Bard is superintendent and O. J. Casaday office manager.

The Edgerton, Indiana, station work is 20 per cent completed. The field office for this job is at Fort Wayne. Earl S. Powell is superintendent and H. H. Voss office manager.

▸ **Brown and Root, Inc.,** P. O. Box 3, Houston, Texas, has a contract with United Gas Pipe Line Company covering various phases of engineering, construction and other services on more than 1000 miles of pipe line to be laid in Texas, Louisiana, and Mississippi.

The contractor also has underway the laying of 88.7 miles for United of various size pipe line, 6⅝ to 16 in., from the West Bay field of Plaquemines Parish, Louisiana, to New Orleans. The field office is at Harvey, Louisiana. J. W. Kincy is superintendent and T. M. Strong is in charge of the office.

Williams-Austin Company, Grant Building, Pittsburgh, 19, Pennsylvania, has several jobs contracted or underway for the New York State Natural Gas Corporation, as follows:

In the South Bend storage field, 4.5 miles of 20-in. Laying operations began the week of May 7. Ralph Gaddy is superintendent and E. E. Mayes timekeeper. The warehouse is at New Kensington, Pennsylvania.

From the Boom storage field to Ithaca, New York, 37 miles of 20-in. Right-of-way is in progress. Laying operations to begin July 1. Warehouse at Horseheads, New York. D. L. Swartz is right-of-way foreman and R. L. Swartz timekeeper.

From State Line station to Angelica, New York, 23 miles of 20-in. Right-of-way in progress. Laying operations to begin September 1.

From Utica to Ithaca, New York, 82.5 miles of 20-in. Laying operations began May 15. The warehouse and field office are at Sauquoit, New York. Leman Creech is superintendent and L. A. Franks timekeeper.

From Knox to Schenectady, New York, 12 miles of 16-in. Right-of-way and ditch in progress. Warehouse is at Altamont, New York, with Howard Bauer superintendent and R. H. Condry timekeeper.

The contractor also has in progress the laying of approximately 40 miles of 10, 12, and 16-in. laterals for the Niagara Mohawk Power Corporation in the Utica and Albany areas. Two spreads are being used, one at Albany under Howard Bauer and the other at Utica under Leman Creech.

Houston Contracting Company, 2707 Ferndale Place, Houston, Texas, has the following construction work under contract:

Approximately 158 miles of 30-in. gas line for Tennessee Gas Transmission Company. This work consists of four sections extending from the vicinity of Jones, Louisiana, on the north to near Cypress, Texas, on the south. Work to be done by three spreads located as follows:

One spread is handling the north end of this work and has its headquarters at Bastrop, Louisiana. W. H. Hayes, superintendent; M. L. Thompson, assistant superintendent; J. C. Strickler and J. B. Stoddard, office. Preliminary right-of-way work began May 8.

One spread is handling the center section with headquarters at Natchitoches, Louisiana. E. C. Norris, superintendent; R. E. Thornton, assistant superintendent; R. J. Axsom, office. Job in progress.

One spread is handling the south end from Conroe, Texas. F. A. Silar, superintendent; C. V. Oliver and L. F. Redfearn, office. Job in progress.

Approximately 42 miles of 10-in. gas line has just been completed for Humble Oil and Refining Company from the Anahuac gasoline plant near Anahuac, Texas, to the Gulf States Utilities plant near Beaumont, Texas. One spread has its headquarters at Winnie, Texas; J. A. Cantrell, superintendent; J. B. Stoddard, office. One spread is at Beaumont, Texas; H. L. Leake, superintendent; S. B. Harrison, assistant superintendent; H. C. MacWhinnie, office.

Gulf Southern Contractors, 516½ Louisiana Avenue, Shreveport, Louisiana, which is a contracting group composed of Texas-Louisiana Contractors, Oklahoma Contracting Company, J. Ray McDermott and Company, Inc., Morrison-Knudsen Company, Inc., has been awarded a contract by United Gas Pipe Line Company to lay 1000 miles of pipe line in Louisiana, Texas, and Mississippi, and approximately 15 miles of 20-in. into the Gulf of Mexico from the coast of Louisiana.

Williams Brothers-Davis Company, 6006 Jensen Drive, Houston, Texas, presently is engaged in the construction of 165 miles of 30-in. pipe line for Texas Eastern Transmission Corporation from Kosciusko, Mississippi, to Florence, Alabama. The field office is at Kosciusko. Dick Hamilton is superintendent and E. F. Lattery office manager.

Anderson Brothers Corporation, 707 Drennan Street, Houston, Texas, recently contracted to lay 100 miles of 24-in. for Michigan Consolidated Gas Company between Big Rapids and Farmington, Michigan.

Other jobs underway or contracted are as follows:

Panhandle Eastern Pipe Line Company, 90 miles of 26-in. from Toledo, Ohio, to Detroit, Michigan.

Miami Valley Corporation, 58 miles of 8-in. from Dayton to Cincinnati, Ohio. Ray Bendure is supervising this work.

Tennessee Gas Transmission Company, 90 miles of 30-in. between Drew and Holly, Mississippi, and 68 miles of 30-in. from Horse Cave to Campbellsville, Kentucky.

Trunklin Gas Supply Company, 214 miles of 14-in. between Garwood, Texas, and Longville, Louisiana, and 180 miles of 26-in. from Oak Grove, Louisiana, to Senatobia, Mississippi. One spread has its headquarters at Leland, Mississippi. J. A. Brown is superintendent. Another spread is working out of Senatobia, with Rusty Killingsworth supervising.

Vaughn and Taylor Construction Company, Inc., P. O. Box 1351, Wichita Falls, Texas, is laying a gathering system for Phillips Petroleum Company in Sherman County, Texas, consisting of 165 miles of 3-in. through 12-in. pipe.

For Sunray Oil Corporation, a gathering system is being laid in the Snyder field, Texas. This is 138 miles of 3-in. through 20-in. pipe.

Geneva Construction Company, Aurora, Illinois, has under construction for Great Lakes Pipe Line Company, 54 miles of 8-in. products pipe line in Iowa. The field office is at Montezuma. W. A. Hamilton is superintendent and George W. Smith office manager.

Latex Construction Company of Georgia, Box 56, Northside Branch, Atlanta, Georgia, is doing considerable pump station and terminal work for Plantation Pipe Line Company. Station buildings are being enlarged at Baton Rouge, Louisiana; Collins, Mississippi; Akron and Silver Run, Alabama; Bremen and Center, Georgia, and Spartanburg, South Carolina. Terminals are being enlarged at all main points between Baton Rouge and Charlotte, North Carolina.

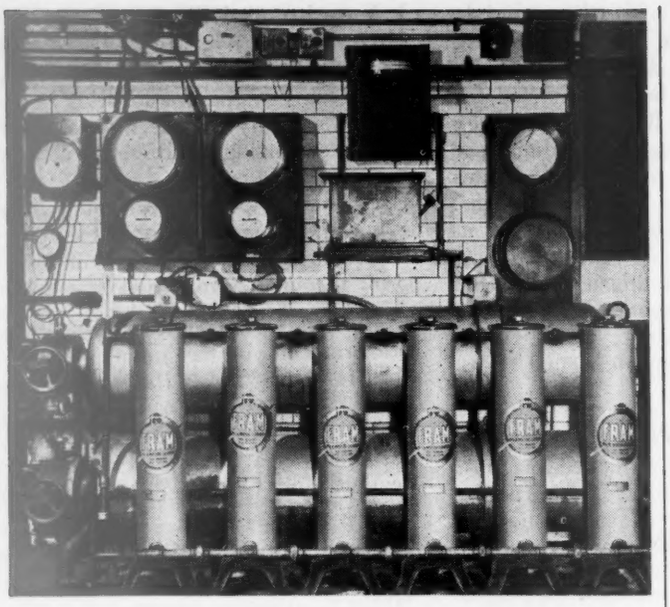
Western Pipe Line Constructors, Inc., Lockhart Building, Austin, Texas, has begun work with two spreads on 121 miles of 30-in. for Tennessee Gas Transmission Company. In addition, crossings will be installed at the Duck, Buffalo, and Tennessee rivers.

One spread is laying 59 miles of line from Parsons to Dickson, Tennessee. A field office has been established at Dickson, Tennessee, with Jack Hodges superintendent and A. G. Goyne office manager.

Work on the section from Richmond to Salt Lick, Kentucky, 62 miles, is out of Mt. Sterling, Kentucky. W. B. Williams is superintendent and P. O. Rutledge office manager.

Jayhawk Construction Company, Great Bend, Kansas, is constructing 128 miles of 6, 8, and 10-in. pipe line in Nebraska for the Kansas-Nebraska Natural Gas Company. Swede Johnson is in charge of the work, and Morgan Blair is managing the office, which is at Central City, Nebraska.

McVean and Barlow Pipe Line Construction Company, P. O. Box 151, Odessa, Texas, is laying 75 miles of 6, 8, and 10-in. pipe for Texas-Harvey Pipe Line Company between Midland and Upton Counties. The spread is working out of Odessa with Eddie Miller in charge.



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▸ **R. H. Fulton and Company,** P. O. Box 1526, Lubbock, Texas, is laying some 16-in. pipe on the Platte Pipe Line Company system. This is the only pipe so far received by Platte. A field office has been opened at Thermopolis, Wyoming, with A. A. Carrigan superintendent and Dane Wagner office manager. In all, Fulton will lay the section from Chatham station in Wyoming to Brule, Nebraska, approximately half of the 1072-mile system.

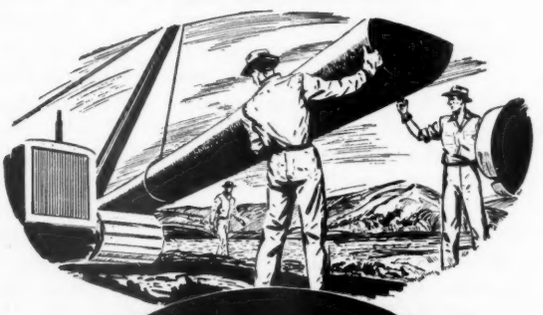
For Trunkline Gas Supply Company, the 184-mile section of 26-in. from Senatobia, Mississippi, to Joppa, Illinois, is being laid. One field office is now at Union City, Tennessee, with Ed Veach superintendent and Vance Albers and Chuck Stewart in the office. Another office is at Halls, Tennessee, where Oscar Phillips is supervisor. Clark Williams is general superintendent.

▸ **Tulsa Pipe Coating Company,** P. O. Box 3085, Whittier Station, Tulsa, Oklahoma, began June 1 the coating of 237 miles of 26-in. pipe for Northern Natural Gas Company that will be laid between Palmyra, Nebraska, and Skellyville, Texas. Buck Rogers is superintendent. Since May 1 work has been going forward for the same company on 200 miles of 4-in. through 12-in. pipe, which will be laid as a gathering system in the Hugoton, Kansas, area. K. C. Honn is in charge of this work.

Also beginning June 1, 147 miles of 1-in. through 8-in. pipe is being coated for Associated Gas Company. The pipe is being used in a distribution system at Sikeston, Missouri. H. Duboise is superintendent of the job.

The following work is being done for various companies: at the Tulsa yard, 50 miles of 2-in. through 24-in., Elvin Lair superintendent; at the Oklahoma City yard, 60 miles of 2-in. through 20-in., Lloyd Latham superintendent, and at the Kansas City yard, 40 miles of 2-in. through 16-in., with Wayne Elgin the superintendent.

America's Foremost Pipeline Constructors



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NEWS

Texas Maintains High Production in June

Texas will produce about 2,939,868 bbl of crude oil per day during the month of June, according to allowables set by the Texas Railroad Commission. This is 10,810 bbl below May 12 figures, but new wells add about 10,000 bbl a week. East Texas oil field will remain on 19 days' flow for the 30-day month, boosting its daily average 8593 bbl to 282,056 bbl. Other fields will operate 23 days instead of 24, reducing the daily average 8649 bbl in the Midland district and other areas by smaller amounts.

Gas Price-Fixing Approved

A Texas Senate committee has approved the house-approved bill permitting the Texas Railroad Commission to set minimum field prices for natural gas to avoid waste.

The Senate committees' 9 to 6 vote matched that of the house, which gave a 72-43 passing vote on the bill. Proponents of the bill argued that the bill was to control waste and hold off the threat of federal action on gas. They said price-fixing would follow only after public hearing.

Hard to Get Drill Pipe

The Petroleum Administration for Defense has turned down about ¼ of the applications for drill pipe priorities in the third quarter of the year. Rejections were primarily for two reasons:

1. Drill pipe on hand or in use by the applicant was in suitable condition to permit continued operation through the third quarter.

2. The total tonnage of drill pipe available during the quarter will be less than the quantity requested.

PAD spokesmen reminded operators that applications for priorities on oil field tubular goods for fourth-quarter delivery must be submitted before July 1.

Naval Petroleum Office In Denver, Colorado, Moves

The office of the Director, Naval Petroleum and Oil Shale Reserves is being relocated in Denver, Colorado, according to Captain R. H. Meade, director. New address will be Suite 410, Mining Exchange Building, 1030 Fifteenth Street, Denver. Mail directed to this office arriving on or after June 15 should be sent to the new address. It is expected that the office in Denver will be formally opened July 2. No replies or action can be expected during the period June 15-July 2.

World Oil Output Declines In November USBM Report

During November, world crude petroleum production averaged 11,161,000 bbl daily, a decrease of 19,000 bbl daily from the October rate, according to a Bureau of Mines report. Indonesian crude production decreased more than 1,000,000 bbl due to strikes during the first half of the month. Production decreases elsewhere, in barrels daily, were: Saudi Arabia 23,000 bbl (backfill of Trans-Arabian pipe line completed in mid-November); Iraq 11,000; and the United States 9000. Crude oil production in Iran increased 35,000 bbl daily, and Kuwait and Canada each increased daily production 10,000 bbl. Venezuela maintained the October rate of 1,612,000 bbl daily, the report stated.

Crude oil imports by western European nations decreased 44,000 bbl daily to 841,000. The principal importers were, in barrels daily: France 320,000 (October 368,000), United Kingdom 181,000 (206,000), Italy and Trieste 117,000 (121,000), the Netherlands 114,000 (105,000), and western Germany 67,000 (51,000). Venezuelan crude exports totaled 38,600,000 bbl compared with the record exports of 40,200,000 in October. Middle East exports of crude to outside areas averaged 1,005,000 bbl daily compared with 933,000 in October.

U. S. Imports Show Gain

Imports of foreign oil and products increased 135,500 bbl daily during the week ended May 12, the American Petroleum Institute has reported. Imports averaged 974,900 bbl daily as compared with 839,400 bbl daily the previous week.

The following table includes figures showing imports of crude oil and residual fuel oil during the 4 weeks ended May 12.

Four weeks ended	Crude oil	Residual fuel oil	Other products	Total
May 12.....	550,500	327,000	30,800	908,300
Weeks ended				
April 14.....	434,800	479,700	29,300	947,600
April 21.....	575,700	315,900	28,100	929,700
April 28.....	506,000	363,200	20,100	889,300
May 5.....	568,200	238,400	32,800	839,400
May 12.....	552,000	390,800	32,100	974,900

CARE Notes 5th Year

In honor of its fifth anniversary, CARE has published a booklet, titled "Ten Million Ambassadors". The booklet portrays the work this organization is doing to relieve starvation in war-devasted countries abroad. It is fully illustrated with pictures depicting the final destination of CARE packages and the people who receive them.

Iran Plans to Nationalize Oil Industry

Despite British protests, Iran has taken steps to nationalize its oil industry, and take charge of the Anglo-Iranian Oil Company properties. The new premier, Mohammed Mossadegh, was appointed after Hussein Ala, former pro-western premier resigned in protest against the parliament's failure to consult the government before pushing through the new oil bill.

Anglo-Iranian Oil Company invoked arbitration clauses of its 1933 concession contract, but the Iranian Government has indicated it will reject this proposal as it has earlier protests against nationalization of the company's properties. The new premier refused the company's arbitration offer of the threatened cancellation of its concession, stating that nationalization is the sovereign right of any nation. He made it plain he believes the 1933 contract was negotiated under duress and is invalid.

NPA Stops July Quota Of Steel for Iran

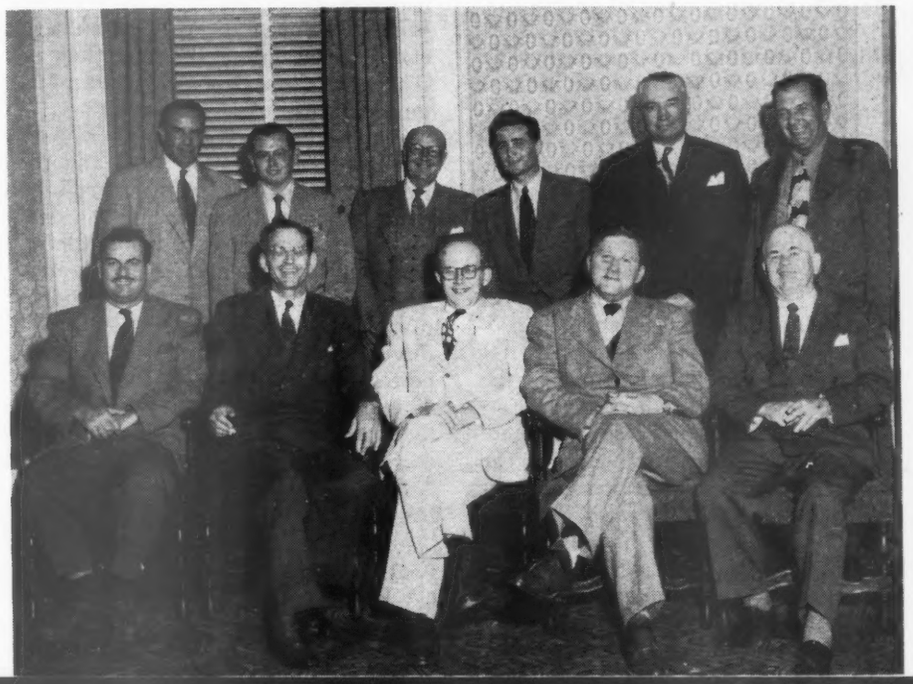
The National Production Authority has decreed that no steel will be shipped to Iran in July due to recent nationalization. The NPA approved allotments of oil-country tubular goods —casing, tubing, and drill pipe—for other countries. A PAD spokesman said a July allotment was requested by Anglo-Iranian Oil Company, but not granted. There was a feeling "they could get along without it more easily than the others," the official explained. The significance of this decision was minimized by the spokesman, as most steel for Iranian wells is supplied by Britain, and also, he stated, U. S. will probably resume shipments to Iran in August.

Kuwait Sheik Expects 50-50 Split of Oil Profits

The sheik of Kuwait has expressed belief that the Anglo-American owned Kuwait Oil Company will soon divide the profits with him on its rich oil concession. Ruler of Kuwait, Sheik Abdulla is seeking oil royalties comparable to those given other Middle East countries. Kuwait is just across the Persian Gulf from Iran. Half the Kuwait company is owned by Anglo-Iranian Oil Company, now being nationalized by Iran. The other half belongs to Gulf Exploration Company of the United States. On Kuwait's daily production of 500,000 bbl, Sheik Abdulla receives a royalty of 9 cents a barrel, or $45,000 daily. A 50-50 split of production profits probably would bring a five-fold increase of payments to him.

Carl Zamloch, vice-president Signal Oil and Gas Company, entertained Los Angeles Nomads with sleight-of-hand at April meeting.

L. A. Nomads. Front row: Sam W. Landis, L. Saavedra e Hijos; Z. W. McCoy, Caltex; Charles Wilkinson, formerly Drilling and Exploration Company; O. M. White and Ralph H. Connors, Iraq Petroleum Company. Back row: T. S. Foster, N. V. Standard Vacuum Petroleum MIJ; Manuel Carrera, Empresa Petrolera Fiscal, Peru; Hugh Thompson, Richmond Exploration; Norman M. Bain, Shell (London); J. D. Bryan, Superior Pipe Service (Venezuela); A: F. Michel, Phillips Oil (Venezuela).



L. A. Nomads Enjoy Evening of Black Magic

Los Angeles Chapter Nomads turned out in goodly numbers on April 11 for the regular monthly meeting in the Marine Room at the Jonathan Club, and enjoyed another fine exhibition of legerdemain by that very fine card manipulator, Carl Zamloch, vice president of Signal Oil and Gas Company. Using Chapter President Jerry Engstrand and Sergeant-at-Arms Jim Hughes as his aides, Zamloch mystified them as well as everyone else with an amazing assortment of smoothly performed tricks.

Jim Hughes was toastmaster for the evening and did a high class job of it. He presented for the further entertainment of the gathering a color film, "The House That Faith Built." This was the story of the Anhauser-Busch Company, told to demonstrate the virtue of free enterprise.

Buys Oil, Gas Properties

Stanwood Oil Corporation of New York City has purchased almost 12,000 acres of proved crude oil and gas properties in Venango, Warren, and Forrest, Pennsylvania. The transaction, purchase price of which was not revealed, included properties owned by the David B. McCalmont estate since 1860.

Red China Seizes Property Of British Oil Company

All property belonging to the British-owned Asiatic Petroleum Company has been seized by Communist China, the Peiping radio has announced. The order applies to all oil stocks, installations, barges, tank cars, and other equipment of what is considered the largest single foreign concern in China. It was the first seizure of British property in China.

Sinclair to Test Ideas For Independent Inventors

Sinclair Oil Corporation has announced that it will make a portion of its laboratory capacity in Harvey, Illinois available to independent inventors for the researching, developing, and proving out of ideas for better petroleum products. Ideas will be invited from inventors everywhere. The directors of the lab will select from among the ideas submitted those which show the most promise, the number being determined by the Laboratories' available capacity at the time. Ideas will be submitted with the provision that they are protected with a patent application or a patent.

When an idea is selected, Sinclair will make an arrangement with the inventor, so that it may use the invention free of royalties.

Tide Water Reactivates Oil Company in Japan

Tide Water Associated Oil Company's business interests in Japan are again assuming sizable proportions, it was announced at the company's annual meeting in New York by William F. Humphrey, president.

Before the war the company was engaged in a 50 per cent partnership with the Mitsubishi interests, which operated a refinery in Kawasaki, near Tokyo. During the war the refinery was seriously damaged by bombing, but since the end of World War II it has been repaired extensively so that at the present time it again has a refining capacity of 4500 bbl per day.

Tide Water's investment in Mitsubishi Oil Company was written off soon after the beginning of the war. The rehabilitation of the company and its properties called for large expenditures, financed principally through bank loans in Japan. That country's currency has depreciated since the war, so that at present the exchange rate is 360 yen for $1, whereas before World War II, the exchange rate was 2 yen for $1.

"Mitsubishi expects to improve its position further on completion of facilities for the manufacture of lubricating oils scheduled for completion next year," Humphrey said.

OIIC Holds Spring Meet In Santa Fe, New Mexico

The Interstate Oil Compact Commission met in the La Fonda Hotel in Santa Fe, New Mexico, recently for its regular spring meeting. General sessions of the meeting were held in the state capitol, house of representatives' chambers, with Governor Allen Shivers presiding. Governor Edwin L. Mechem, New Mexico, opened the first general session welcoming the commission members and guests. Governor Johnston Murray, Oklahoma, responded to the address with a talk on "Conservation — A Privilege." He praised the conservation laws of the oil and gas producing states, pointing out that "the industry enjoys benefits of a well-planned, well-regulated program."

Governor Shivers, chairman of the commission, told of the introduction resolutions to extend the Interstate Compact to conserve oil and gas for another 4 years after September 1 in the U. S. Congress. He also reported that the excess producible reserve in the Compact states today is only 439,-173 bbl daily as compared with the figures submitted to the president by the Compact in August, 1950, of 1,139,487 bbl daily. Should total war cut off foreign imports of oil, domestic production—even at maximum capacity—would be 500,000 bbl a day short of supplying the nation's requirements, Shivers told the meeting.

William J. Murray, Jr., member of the Texas Railroad Commission discussed "The States' Problems and Responsibilities Today". He enumerated the states regulatory bodies' responsibilities as advancing conservation, preserving equities, preventing confiscation, protecting freedom of enterprise, encouraging exploration and development, and at the same time assisting the federal authorities to minimize the use of steel.

A panel of six Washington officials discussed "The Nation's Oil and the Defense Program", with Carroll D. Fentress, special assistant to the deputy administrator, Petroleum Administration for Defense, as moderator. R. G. Lawton, chairman of production, PAD, pointed out in this panel discussion that the industry is expected to reach the minimum goal of 43,400 wells in 1951, and thus assure the nation of minimum adequate reserves and capacity to meet its needs.

Arizona became an associate member of the Compact at the business meeting. Governor J. Howard Pyle filed applications for Arizona's associate membership in the commissioin.

A part of the meeting was devoted to reports of the standing committees and advisory committees. The Secondary Recovery Advisory committee heard a discussion by Wellford Martin, Oil Recovery Corporation, New York City, who spoke on the recently developed process of injecting carbon dioxide gas into depleted oil reservoirs as an aid to secondary recovery.

Highways Essential in Future Planning: Crockett

Albert G. Crockett, Mack Trucks, Inc., laid down a 4-point highway program in Akron, Ohio, recently to insure national security and sound planning for the future.

They are: *One:* This country must look ahead and build highways to meet the traffic demands of modern commerce and industry. "We must have roads built to fit the traffic," he said.

Two: Roads are tools. They are means to an end. In many places today we need heavier roads to do the modern job of carrying modern traffic.

Three: We must pay more attention to what's under the road. Most highway damage comes from improper construction of the soilbed—not from the loads carried by the road itself.

Four: We believe that trucks and all who benefit from highway transportation should pay their own way. But highway users should not be asked to bear more than their fair share of the expenses of government.

Oil Industry Speeches

A comprehensive picture of all phases of the petroleum industry, from exploration to marketing, is provided in 13 pattern speeches now being distributed to thousands of members of the Oil Industry Information Committee. The addresses, prepared in offset form, contain the latest available statistics from industry and government sources.

Oil Workers Make New Safety Record

The petroleum industry in 1950 achieved the best safety record of its history, according to the annual survey compiled by the Department of Statistics of the American Petroleum Institute. The study shows that the chances of an oil employee being injured fatally or permanently disabled now are about 5900 to one, against an average of 4400 to one in 1949 and 2800 to one in 1946. The number of employees fatally injured or permanently disabled during 1950 was 81, a 26 per cent improvement over the 109 reported for 1949.

Sunbeam Oil Formed

The Sunbeam Oil Company, a corporation, was recently organized under a Delaware charter by Walter Duncan, Jr., and Robert J. Beams of Oklahoma City, Oklahoma, and Howell and Howell of Dallas, Texas. This company has initiated its operation in Oklahoma and established an office at 2212 First National Building. Officers were elected as follows: G. B. Howell, president; Robert J. Beams, vice president and chief geologist; Vernon Howell, vice president, and Walter Duncan, Jr., secretary-treasurer.

The Sunbeam Oil Company plans to concentrate its exploration program in Southern Oklahoma and particularly in Carter and Stephens counties. An office under the direction of Beams will be established at Ardmore, Oklahoma in August.

Duncan, an independent operator has extensive oil production in Oklahoma, Illinois, and West Texas. Beams was formerly with the Shell Oil Company and more recently was a consultant at Oklahoma City.

Free Science Benefits All, Greenwalt Tells Audience

As long as science remains free to accumulate new knowledge, it will contribute to the strength and defense of the nation and the welfare of everyone, Crawford H. Greenewalt, president of the Du Pont Company, said in dedicating that organization's new experimental station laboratories "to the challenging tasks that lie ahead."

He declared it "essential" to recognize that the vast social and material gains America has made in the last five decades "have not been accomplished by legislation, by deals, old, new or fair, but simply through the application and encouragement of invention and development."

Haifa May Again Become Middle East Oil Center

M. D. Steel, a representative of Anglo-Iranian Oil Company is in Jerusalem discussing oil matters with the Israel ministry's fuel adviser, I. Kosloff. Outcome of the talks may make Haifa the foremost oil center in the Middle East, following latest developments in Iran and other Middle East oil-producing countries. One of the main topics of discussion is operation of the Haifa refineries in which Anglo-Iranian is an important stockholder. These, which are now nearly idle, are supplied crude oil by Shell and Socony-Vacuum affiliates. They may now expand their present output to export again to European markets. Employees are being added steadily.

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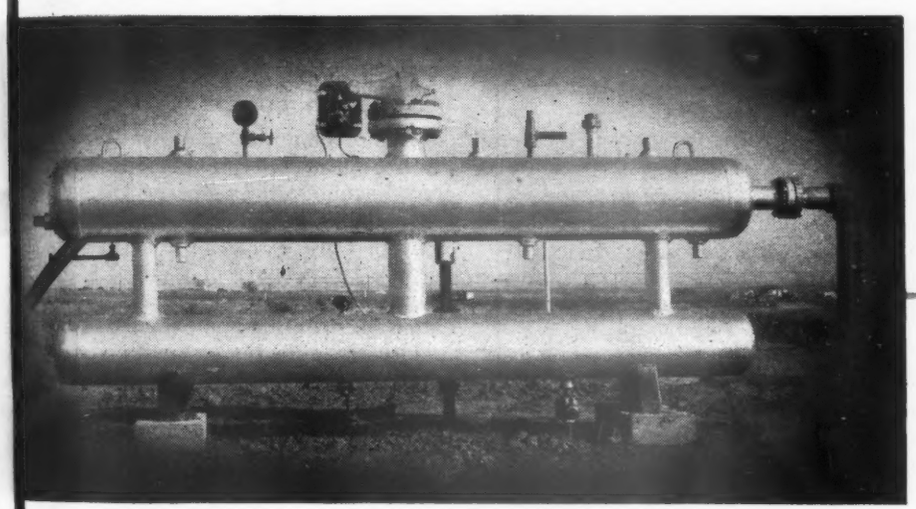

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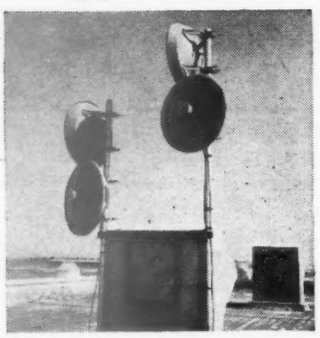
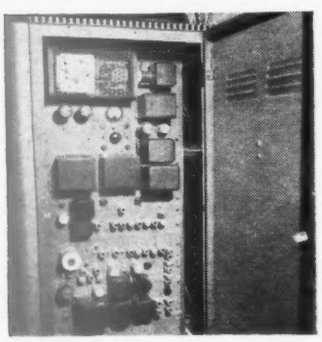
RCA MICROWAVE SYSTEM



Two links of receiving and transmitting antennas of Central Arizona Light & Power Co., located on roof of generating plant.



RCA Microwave Transmitter-Receiver. The generating plant and each switching station has a transmitter-receiver.

SINCE June 1949, the Central Arizona Light & Power Company, Phoenix, Arizona has used an RCA Microwave System for remote control of switchgear . . . telemetering of voltage, current and power . . . two-way voice communication —between a generating plant and two remote switching stations.

Despite severe lightning storms, temperatures of 140 F, unusual exposure to wind, sand, dust, and insects, RCA Microwave equipment has provided excellent continuity of service.

Reliable Performance, Lower Costs

This modern system of communication costs less per mile to construct and operate than conventional wire or carrier current systems. Parabolic antennas focus transmitted signals to span distances up to 35 miles. Repeater stations provide a path for signals over mountains, rivers and rolling countryside. The equipment is designed for unattended operation and may be installed at locations which are inaccessible for periods of several months. Channels are provided for supervisory control, teleprinter, facsimile, two-way radio, and many other circuits.

RCA engineers are at your service for consultation on microwave systems. Write to Dept. R-152 for complete information.

MICROWAVE COMMUNICATIONS SECTION
RADIO CORPORATION of AMERICA
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In Canada: RCA VICTOR Company Limited, Montreal

Murray Opposes FPC Gas Price Fixation

W. J. Murray, Jr., member of the Texas Railroad Commission, said that the price of gas has a definite relation to conservation in his testimony in the Federal Power Commission hearing at Bartlesville, Oklahoma, recently. The hearing is being held to determine whether Phillips Petroleum Company is a natural gas company under the Natural Gas Act. Testifying for the intervener, the State of Texas, in opposition to FPC regulation of gas producers and gatherers, Murray said that the fundamental purpose of conservation is to produce and utilize the greatest possible quantity of gas from each reservoir.

Murray was opposed to the fixation of prices of gas at the well either minimum or maximum but felt that they should find a level through competition between different producers and buyers of gas as well as competition between the different fuels.

Socony's Oil Activities Increase in Europe

Despite the impact of World War II on European operations of the Socony-Vacuum Oil Company, Inc., the company is bigger and stronger in Western Europe than ever before, according to the current issue of "The Flying Red Horse," employees' publication. Restoration and expansion was undertaken after the war with a view to making the company's Western Europe operations "better balanced" and "more self-sufficient." Primarily the company had been a marketer in the area, and, to a limited extent, a refiner. To an even lesser degree it was a producer and supplier of crude oil for its own use.

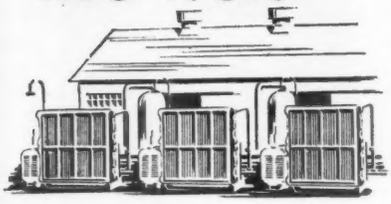
Total refining capacity available to Socony-Vacuum companies in Western Europe will average almost 90,000 bbl per day for this year, compared with 58,000 bbl in the prewar period.

More Engineers Needed

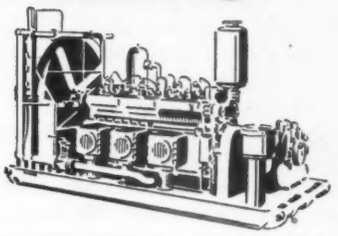
More than 30,000 engineers must be graduated each year from the engineering schools to staff the national effort to out-design, out-develop, outproduce, and out-perform a potential enemy who outnumbers us greatly, the Engineering Manpower Commission of Engineers Joint Council has reported. This is a conservative estimate. But in order to achieve it engineering schools will have to more than double their present enrollment for years to come.

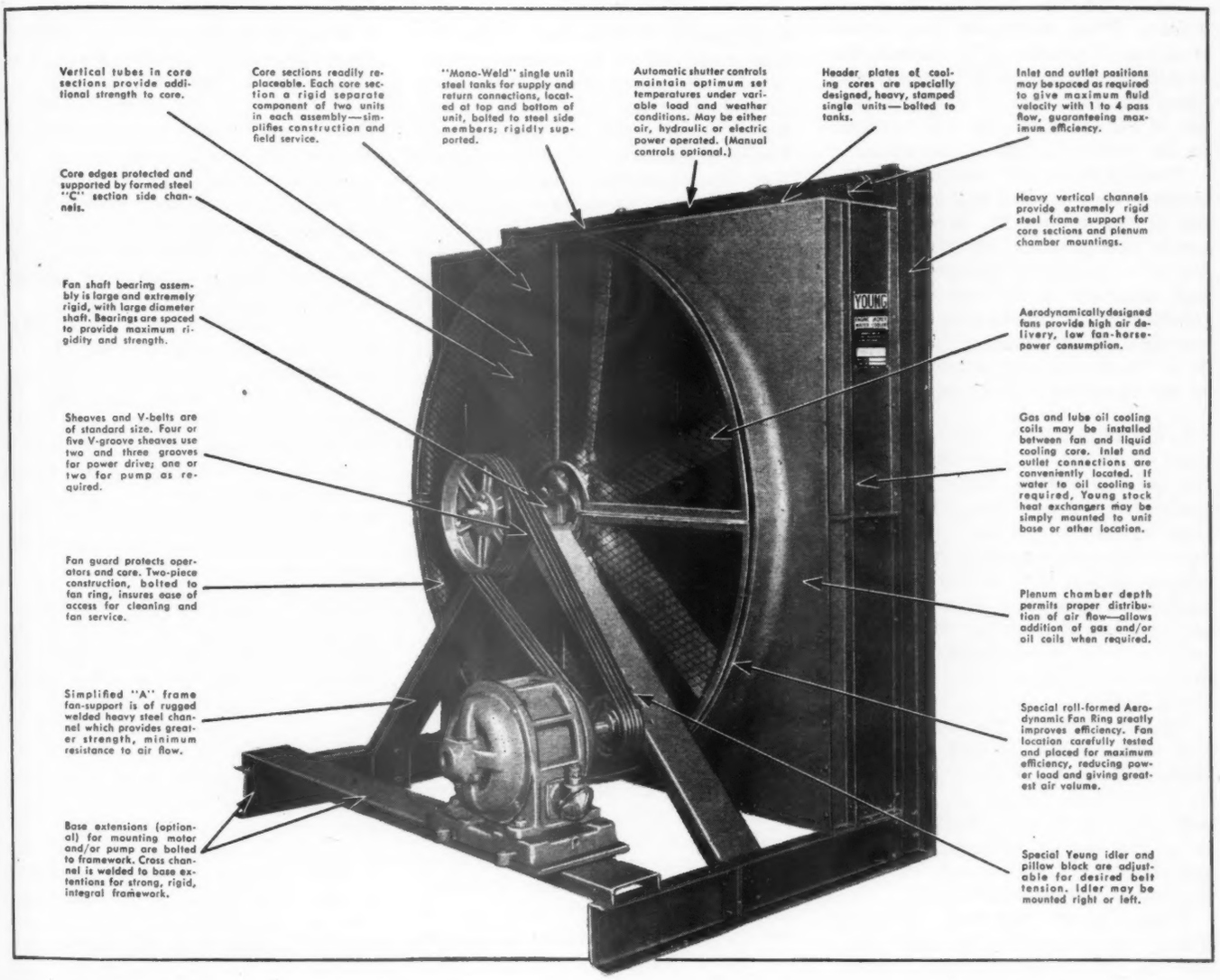
Since the "mortality" rate in engineering schools is about 50 per cent, an annual freshman enrollment of 60,000 would be required.

Presenting the New YOUNG Jacket Water Coolers



Greater cooling capacity...more compact, rugged design for gas, gasoline, Diesel engine applications . . . . .




Vertical tubes in core sections provide additional strength to core.
Core sections readily replaceable. Each core section a rigid separate component of two units in each assembly—simplifies construction and field service.
"Mono-Weld" single unit steel tanks for supply and return connections, located at top and bottom of unit, bolted to steel side members; rigidly supported.
Automatic shutter controls maintain optimum set temperatures under variable load and weather conditions. May be either air, hydraulic or electric power operated. (Manual controls optional.)
Header plates of cooling cores are specially designed, heavy, stamped single units—bolted to tanks.
Inlet and outlet positions may be spaced as required to give maximum fluid velocity with 1 to 4 pass flow, guaranteeing maximum efficiency.
Core edges protected and supported by formed steel "C" section side channels.
Heavy vertical channels provide extremely rigid steel frame support for core sections and plenum chamber mountings.
Fan shaft bearing assembly is large and extremely rigid, with large diameter shaft. Bearings are spaced to provide maximum rigidity and strength.
Aerodynamically designed fans provide high air delivery, low fan-horsepower consumption.
Sheaves and V-belts are of standard size. Four or five V-groove sheaves use two and three grooves for power drive; one or two for pump as required.
Gas and lube oil cooling coils may be installed between fan and liquid cooling core. Inlet and outlet connections are conveniently located. If water to oil cooling is required, Young stock heat exchangers may be simply mounted to unit base or other location.
Fan guard protects operators and core. Two-piece construction, bolted to fan ring, insures ease of access for cleaning and fan service.
Plenum chamber depth permits proper distribution of air flow—allows addition of gas and/or oil coils when required.
Simplified "A" frame fan-support is of rugged welded heavy steel channel which provides greater strength, minimum resistance to air flow.
Special roll-formed Aerodynamic Fan Ring greatly improves efficiency. Fan location carefully tested and placed for maximum efficiency, reducing power load and giving greatest air volume.
Base extensions (optional) for mounting motor and/or pump are bolted to framework. Cross channel is welded to base extentions for strong, rigid, integral framework.
Special Young idler and pillow block are adjustable for desired belt tension. Idler may be mounted right or left.
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Heat Transfer Products for Automotive and Industrial Applications.

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From the many features shown above, you can see that *extra ruggedness* is built into every component of improved Young Jacket Water Coolers. The result is a unit that will last the life of the power plant . . . one that excels in mobile service—that has the necessary compactness and ample capacity for field duty on portable equipment.

Young designing permits the addition of lube oil and/or gas cooling coils between the water cooling core and the fan, making possible a lower fan-horsepower requirement.

Catalog No. 1351 plus ratings, specifications and other details will be furnished upon request. See your nearest Young Distributor, or write direct.

PERSONALS

▸ **K. S. Adams,** president of Phillips Petroleum Company since 1938, was recently elected chairman of the board and chief executive officer and chairman of the executive committee. The action was taken by the board of directors at a meeting held after the company's annual meeting of stockholders in Bartlesville, Oklahoma.

Upon the recommendation of Adams, **Paul Endacott** was elected president. Endacott, as executive vice president and assistant to the president, has been the operating manager of the company and will continue in the same capacity as president.

Stanley Learned was elected executive vice president and assistant to the president. **W. W. Keeler,** formerly vice president of refining, was elected a director, and vice president and assistant to the executive vice president. **C. C. Tate** was appointed manager of the refining department. **J. E. Bogk** was appointed chairman of the operating committee.

▸ **J. E. Kline** of Standard Oil Company (Indiana) is new chairman of the Chicago section of the Society of Automotive Engineers. Announcement of his election was made at the section's monthly meeting in Chicago, Illinois. Kline, head of the Stan-Add additive division of Standard Oil's sales technical service department, succeeds **T. A. Scherger** of the Studebaker Corporation at South Bend, Indiana.

Other officers of the Chicago section SAE for the 1951-52 season include **Robert C. Wallace,** Diamond T. Motor Car Company, vice-chairman; **Lloyd F. Overholt,** International Harvester Company, secretary; and **David C. Peterson,** Stewart-Warner Corporation, treasurer.

Kline joined Standard Oil (Indiana) as automotive research engineer in 1937 upon graduation from the University of Michigan.

▸ **J. H. Thacher** has been appointed executive assistant to the vice president of Standard Oil Company of California. Thacher, formerly Standard's southern district producing manager, will handle work in connection with the company's Elk Hills operating contract with the Navy.

Other personnel moves by Standard's producing department names **W. C. Johnson** as manager, Southern district; **M. W. Morris,** general superintendent, Southern district; **K. B. McNamara,** district petroleum engineer, Southern district.

Tracy T. Word, Jr.

Edmond L. Lorehn

▸ **Edmond L. Lorehn,** executive vice president of the Cameron Iron Works, Houston, Texas, has been elected chairman of the National Board of Regents of Nomads, and **Tracy T. Word, Jr.,** sales manager, Well Equipment Manufacturing Company, was named secretary-treasurer. They succeed Fred C. Ripley, Jr., International Derrick and Equipment Company, former Chairman, and Lee J. Laird, Baash-Ross Tool Company, 1950 secretary-treasurer.

Lorehn was educated at Dean Academy of Franklin, Massachusetts, Thomas College, and Rice Institute of Houston. He joined Cameron Iron Works in 1920, and in 1950 was named executive vice president. He was 1950 president of the Houston chapter of Nomads. Word, who attended the University of Oklahoma and Texas University, was first employed by his father, T. T. Word Supply Company. He joined Well Equipment sales organization in 1944, and became sales manager in 1946.

▸ **W. L. Templin** has been named division industrial relations supervisor for Stanolind Oil and Gas Company's central division. Templin had formerly served as division wage and salary analyst since September of 1948. He joined Stanolind in April 1940, as a roustabout in the company's Lucien area in central Oklahoma. He went to the central division office in Oklahoma City in 1946.

▸ **Dr. Ralph C. Tallman** has been named director of research for Lion Oil Company. Tallman, who has been manager of the planning and survey department of Lion Oil's research division since June 1950, replaces **Dr. Frank J. Soday,** who has headed the research division since November 1947. Soday has resigned his position to assume the post of director of research for Chemstrand Corporation and will be situated at Decatur, Alabama. Tallman, a native of Cedar Rapids, Iowa, received his A.B. degree from Cornell College and his Ph.D. degree from Cornell University.

▸ **Paul Andrews,** of Signal Oil and Gas Company, Los Angeles, was elected Pacific Coast district chairman of the American Petroleum Institute's Division of Production at the group's 24th annual spring meeting.

Andrews, chief production engineer for Signal Oil and Gas, succeeds **E. C. Babson,** of Union Oil Company of California, Los Angeles. During the past year, Andrews served as general chairman under Babson.

Vice Chairmen elected at the division's business session were: **C. C. Gandaubert,** General Petroleum, Los Angeles Basin area; **W. T. Woodward,** Woodward and Reynolds, Taft, South San Joaquin Valley area; **B. B. Grainger,** Tide Water Associated Oil, Ventura, Coastal area; and **J. C. Chescheir, Jr.,** Trebolite Company, Coalinga, Coalinga-Kettleman Area.

▸ **Burl S. Watson** has been named executive vice president of Cities Service Company, and **Emil Schram,** former president of the New York Stock Exchange, was elected to the board of directors of Cities Service.

Watson, a graduate of the University of Alabama, has been associated with Cities Service since 1917. For many years he was assistant to the president, becoming a vice president in 1940. Prior to becoming president of the New York Stock Exchange, Schram was chairman of the board of the Reconstruction Finance Corporation. He has been awarded honorary doctorates of law from New York University and the University of Vermont.

▸ **Robert A. Laidlaw** has been named to the board of directors of The British American Oil Company. Laidlaw is widely known for his business interests in Eastern Canada. He is a director of various companies including the Bank of Montreal, Bell Telephone Company of Canada, and Moore Corporation Limited. He is president and chairman of the board of the National Trust Company, Ltd., and is vice president of the Canada Life Assurance Company.

Dechard A. (Deck) Hulcy, who educated himself at nights through a correspondence school course, is the new president of the Chamber of Commerce of the United States. He is president of the Lone Star Gas Company, Dallas, Texas, for which he went to work as an accounting department clerk in 1920, and also president of the American Gas Association.

His election to the presidency of the world's largest business organization was announced at the close of the Chamber's 39th annual meeting. He has served on the Chamber's board of directors since 1946 and was a vice president during the past year.

Robert Cameron of Socony-Vacuum Oil Company, Inc., has been elected vice president of the Office Executives Association.

Dr. K. S. Pitzer is resigning, effective June 18, as director of research for the Atomic Energy Commission, to become Dean of the College of Chemistry, University of California.

Sumner T. Pike, acting chairman of the Commission voiced the regret of the Commissioners at Dr. Pitzer's leaving. "He has contributed substantially to a necessary and wide reorientation of Commission-supported basic and applied research in both the National Laboratories and the universities of the nation," he stated.

Robert H. Hope recently became division attorney in Midstates Oil Corporation's Shreveport office. Hope was born in Morehouse Parish, Louisiana and received his law degree from Louisiana State University in 1926. Upon graduation he engaged in the private practice of law in Monroe and Bastrop, Louisiana. In 1944 he joined The Texas Company in their New Orleans office where he remained until his recent move to Shreveport.

C. H. Swan, Humble Oil and Refining Company, has been promoted to district chief clerk, Hawkins, Texas district. Formerly assistant district chief clerk, Swan replaces **A. W. Compton,** who has been transferred to the new Palestine district as chief clerk.

Frank S. Tietz, district chief clerk of the Trawick Gas construction district, was transferred to the Hawkins district as assistant district chief clerk to replace Swan. **O. L. Furse,** assistant district superintendent at London, was promoted to district superintendent at Pickton, replacing **L. O. Holloway,** who moved to the new Palestine district.

Richard K. Huey, has been named assistant to the president of Deep Rock Oil Corporation. He formerly was vice president in charge of production, and was succeeded by **Carl A. Houy,** who has been general superintendent since last year. Huey joined Deep Rock in 1920, and is credited with pioneering the use of electricity for drilling and pumping, and with the early installation of modern pumping units in Oklahoma oil fields. Houy attended Schreiner Institute and the University of Texas, becoming a roughneck with Humble Oil Company 14 years ago.

George M. Muschamp was elected chairman of the Philadelphia Section, American Society of Mechanical Engineers, at the ASME annual meeting. Muschamp is vice president in charge of engineering for Brown Instruments Division, Minneapolis-Honeywell Regulator Company.

Robert W. Worley of United Engineers and Construction, Inc., was elected vice chairman; **James A. Quaid,** Martin Quaid Company, treasurer, and **C. C. Franck,** Westinghouse Electric, secretary.

Wayne Rives, vice president of *The Oil and Gas Journal* in Houston, Texas, has resigned to become a partner in Rives, Dyke and Company, Houston, Texas, advertising agency. A native Houstonian, Rives joined the advertising staff of *The Oil and Gas Journal* in 1935 as advertising representative in the Gulf Coast. In 1946, he was named advertising manager of *The Journal* and *Petroleo Interamericano* with offices in Tulsa. He returned his headquarters to Houston in 1948 when he was elected vice-president in charge of the Gulf Coast division. **John M. Spears,** an assistant to Rives in the Houston office since 1948, will become manager of advertising sales in the Gulf Coast.

Wayne Rives

Frank S. Cannon, Mississippi division manager of Pan-Am Southern Corporation, has retired. He had been the oil company's representative in Jackson since 1926, longer than any other has held a similar post with Pan-Am. Through the years he built a sales organization, which at his coming, sold less than 100,000 gal of gasoline per month to a total today of many millions each month. He will be succeeded by **E. J. Dorgan,** former Louisiana division manager.

Cannon received his education at Christian Brothers College, Memphis, and studied law at the University of Mississippi and later at Tulane University where he received his degree. He joined Pan-Am in Boston, and in 1926 went to New Orleans to work in the company's legal department. A few months later he was transferred to the post in Jackson.

New York Chapter of Nomads at annual invitation dinner, Louis Sherry's, New York.

STOP OIL WELL JOINT LEAKS

Use

SPANGSEAL TUBING

Leaky tubing joints cost you time and money . . . particularly with today's deeper drilling and attendant higher pressures. Our engineers developed SPANGSEAL Tubing specifically to stop joint leakage. Couplings were eliminated by using an integral type connection with standard API threads on male and female ends. Half as many threaded connections—half as many possible points of leakage.

Then the engineers added a special feature to seal off pressure. They specified precision-machined mating conical sealing surfaces at the small end of threads of both members. THESE SEALING SURFACES BEAR THE PRESSURE, LEAVING THE THREADS TO FORM A MECHANICAL LOCK ONLY.

Result: Faster running time, more clearance, less chance of hanging up, and positive protection against joint leakage.

NATIONAL OIL FIELD MACHINERY AND EQUIPMENT ★ SPANG STEEL PIPE ★

To obtain more information on products advertised see page E-45

SPANGSEAL TUBING

features include . . .

INTEGRAL JOINT

Only two threaded elements. Use of couplings, requiring four threaded joints is eliminated. Female joint ends are treated chemically to provide anti-galling surface.

ECONOMICAL

SPANGSEAL Tubing saves you money. Costly repair jobs and remedial work due to leakage are eliminated.

ADDITIONAL CLEARANCE

Extra clearance is obtained because the maximum OD of the SPANGSEAL Joint is smaller than the maximum OD of a coupling.

STREAMLINED EXTERIOR

The streamlined exterior contour of the female end reduces the chance of hanging up while running.

LEAK RESISTANT

Made up properly, threads serve only as a mechanical interlock. Conical sealing surfaces form a complete-circumferential seal.

For complete dependability, specify SPANGSEAL Tubing for your wells.

THE NATIONAL SUPPLY COMPANY

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NATIONAL BLUE PRODUCTS

The Tool Pusher's Best Friend

HANDLE-BAR

REG. U.S. PAT. OFF.

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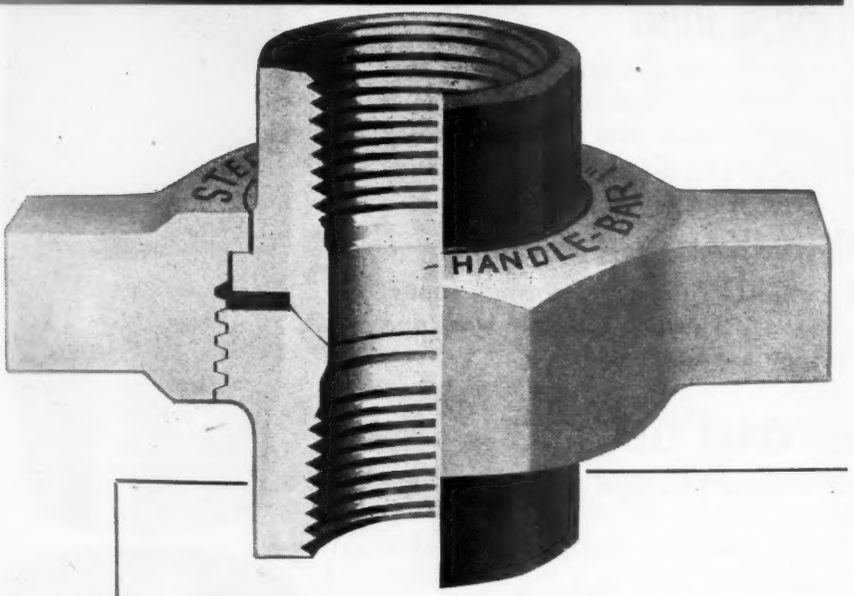

HANDLE-BAR 4000 TEST

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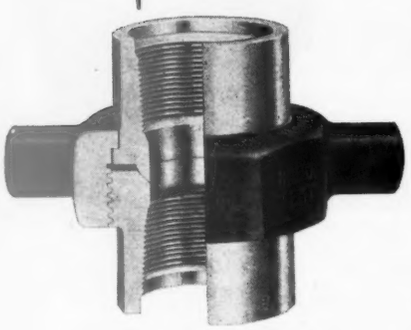
HANDLE-BAR Unions are precision made and tested at time of manufacture to assure a tight seal in seats and threads. These famous features are built into each HANDLE-BAR. Integral steel to steel or bronze to bronze seats. Hub ends tapped Briggs Standard steam threads. Nut threads modified Acme. Furnished black hub ends with Udylite nut, or all rust-proof with Udylited hub ends and Parkerized nut. Recommended for all services and on pressures to 3000 lbs.



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These unions have integral steel to steel seats. The hub ends are tapped A.P.I. line pipe. The nut threads are modified Acme. The hub ends are rust-proofed and spark-proofed with Udylite Cadmium. The nut is Parkerized. These unions are recommended for all oil field services and pressures to 5000 lbs.

Write Dept. P for illustrated catalog or refer to listings in Composite Catalog pages 3140-3141, Refinery Catalog page 538, and Chemical Engineering Catalog pages 980-981.

ORDER BY TRADE NAME FROM YOUR LOCAL JOBBER

ORIGINATORS AND PIONEERS OF STEEL UNIONS SINCE 1912

CLAYTON MARK & COMPANY

1900 DEMPSTER STREET • EVANSTON, ILLINOIS

▸ **Thomas B. Jones,** chairman of the board of Oklahoma Contracting Company, died in Dallas, Texas, recently. One of the founders of the concern, which had its beginning in 1917, Jones was a native of Knoxville, Tennessee. The company was organized in Tulsa, Oklahoma, when Jones' boss, Glen T. Braden, former head of Oklahoma Natural Gas Company, wanted to build a pipe line from Oklahoma City to Chickasha. Jones and Braden's son, Eugene, got Braden to finance them in organizing the contracting company. Two years later Eugene Braden died, and in 1926, Jones moved his operations from Tulsa to Texas.

Oklahoma Contracting Company has laid 12,000 miles of pipe in most oil and gas areas in the western hemisphere, Europe, and the Near East. The company last year reported a $25,000,000 business.

K. Marshall Fagin

▸ **K. Marshall Fagin** has accepted a new position as petroleum engineer in the oil loan department of the Southwestern Life Insurance Company in the company's headquarters building in Dallas, Texas. He has been editor of the Drilling and Producing Edition of The Petroleum Engineer since it was first published separately in January, 1949, and was field editor for The Petroleum Engineer since 1945.

He has been employed by a number of oil companies, including Shell, Tidewater, Stanolind, and Magnolia, since his graduation from the University of Illinois. Before joining The Petroleum Engineer, he had been assistant to the chief petroleum engineer of Magnolia Petroleum Company since 1935.

▸ **Robert H. Williams** of Pitman, New Jersey, of the research and development department, Socony-Vacuum Laboratories, Paulsboro, and **James C. Melrose,** the field research laboratories of the Magnolia Petroleum Company, Dallas, Texas, have been selected to receive 1951 Incentive Fellowship Awards from the Socony-Vacuum Oil Company, Inc., for advanced study.

BIBLIOGRAPHY—Classified list of important papers for 1949 - 1950

Transportation and National Security, F. G. Gurley
Treatment of Pension Costs, Including Those of Non-Funded Retirement Plans, C. A. Jackson
Well-Completion Practices, T. A. Huber, T. O. Allen, and G. F. Abendroth

Spring Meeting
Southwestern District
Division of Production
Hotel Beaumont
Beaumont, Texas
March 7-9, 1951

A New Electrical Well Logging System, R. H. Winn and W. J. Greer
A Report on Oil-Emulsion Drilling Fluids, H. W. Perkins
Conservation Through Regulation, William J. Murray, Jr.
Design of an Electrical Analog for Sucker-Rod Problems, F. C. Todd
Down-The-Hole Pressure Surges and Their Effect on Loss of Circulation, W. C. Goins, Jr., J. P. Weichert, J. L. Burba, Jr.; D. D. Dawson, Jr., and A. J. Teplitz
Employee Morale in a Defense Economy, William R. Spreigel
High-Speed Electronic Reservoir Analyser, O. L. Patterson, K. E. Montague, and Byron Wiess, Jr.
Nozzle Design and Its Effect on Drilling Rate and Pump Operation, John R. Eckel and W. J. Beilstein
Results of Survey on Primary Cementing Practices, Louis F. Davis
Technological Progress During Fifty Years, C. A. Warner
The Job Ahead for Production, J. C. Donnell, II
The Neutral Zones in Drill Pipe and Casing and Their Significance in Relation to Buckling and Collapse, A. Klinkenberg
The Wire-Line Pressure Setting Assembly as Used to Set Tools Having Opposed Slips, C. A. Greve
Thin Oil Column Completions in Louisiana-Mississippi Gulf Coast Area, R. G. Loper

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Mid-Continent District
Division of Production
Herring Hotel
Amarillo, Texas
March 21-23, 1951

Counterbalancing of Beam Pumping Units, D. O. Johnson
Effects of Sodium Chloride on Setting Properties of Oil-Well Cements, N. C. Ludwig
Metallurgical Factors Affecting Drill-Collar Performance, R. J. Stoup
Progress Report—Hildreth Unit Water-Injection Project, Wallace W. Wilson
Review of Quantitative Methods of Electrical-Log Interpretation, S. J. Pirson
Selection and Evaluation of Wells for Hydrafrac Treatment, Joe W. Maley and Tom E. Morton
Straight-Hole Drilling in Crooked-Hole Country, G. C. MacDonald and Arthur Lubinski
The Value of Agents for Control of Silicate Swelling in Acidizing, P. H. Cardwell
Use of Decline Curves in Water-Flooding Operations, John F. Buckwalter
Well Interference Supports Wide Spacing, George R. Elliott

Spring Meeting, Eastern District
Division of Production
Deshler-Wallick Hotel, Columbus, Ohio
April 3-5, 1951

A Discussion of the Effects of Pressure Gradients on Oil Recovery by Water Flooding, John C. Calhoun, Jr.
Confusing an Industry Problem, Russell B. Brown
Field Results of Increased Flooding Pressures, E. T. Heck and J. C. Vaughn
Natural Gas Comes of Age, Stuart M. Crocker
Recent Developments in Exploration in Northern and Central Pennsylvania, S. H. Catheart
Selection of Pressure for Water Flooding Various Reservoirs, John F. Buckwalter
Studies and Experiments With Paraffin Prevention and Removal in Wells in Southeastern Ohio, John C. Wright
Water Flooding of Limestones in Illinois and Kentucky, Kenneth Huffman
Your Part in the Oil Industry Public Relations Program, C. Z. Hardwick

Spring Meeting, Rocky Mountain District
Division of Production
Gladstone Hotel, Casper, Wyoming
April 19-20, 1951

Drilling and Completion Practices in the Church Buttes Field, W. C. Dinger
Low Temperature Separation as Applied to Gas-Condensate Production, A. W. Francis, Jr.
Obstacles in the Battle for Production, J. C. Donnell, II.
Progress of Development Activity, Uinta Basin, Utah, E. A. Polumbus, Jr.
Shannon Sand Reservoir Cole Creek Field, Wyoming, E. J. Whitaker and D. T. Hoenshell
Some Observations of Unusual Tubular Failures, D. C. Neely
The Worland, Wyoming Field, J. I. Morris
Unusual Reservoir Oils in the Elk Basin and Rangely Fields, Ralph H. Espach

Mid-Year Meeting, Division of Refining
Mayo Hotel, Tulsa, Oklahoma
April 30—May 3, 1951

An Ultraviolet Method for the Determination of Total Alkyl Benzenes in Selected Crude Fractions, John F. Kinder
Characteristics of the Spectrographic-Arc Emission of Metal Contaminants in Cracking Catalyst, E. L. Gunn
Chemical Treating Plant for Refinery Waste Water, H. Schindler
Corrosion-Prevention Program for a TCC Unit Gas Plant, C. A. Murray and M. A. Furth
Determination of Iron in Used Lubricating Oils by Spectrochemical Analysis, John Hansen, Paul Skiba, and C. R. Hodgkins
Determination of Oxygen in Organic Material, Morris Dundy and Ervin Stehr
Direct Determination of Oxygen in Organic Compounds by an Unterzaucher-Manometric Method, Joseph Holowchak and G. E. C. Wear
Dissolved-Air Flotation Separates Oil From Waste Water, Nicholas A. D'Arcy, Jr.
Economic Relationship of Engine-Fuel Research, C. L. McCuen
Explosion-Proof Motors Design and Application to the Petroleum Industry, J. Z. Linsenmeyer and C. R. Olson
Formation of Engine-Deposit Compounds by Solid-State Reactions, Frances W. Lamb and Leonard M. Niebylski
Hydraulic Characteristics of Gravity-Type Oil-Water Separators, Gerard A. Rohlich
Hydrogen Attack of Steel in Refinery Equipment, R. T. Effinger, M. L. Renquist, A. Wachter, and J. G. Wilson
Indoctrination Programs for Technical Personnel, F. C. Cutting
Industry Practice in Training Technical Personnel, H. G. Vesper and D. H. Etzler
Infrared Spectrophotometric Determination of Oils and Phenols in Water, R. G. Simard, I. Hasegawa, W. Bandaruk, and C. E. Headington
LP-Gas Distribution, Howard E. Felt
LP-Gas, Over a Million Barrels Daily, R. C. Alden, Forrest E. Gilmore, and Paul W. Tucker
LP-Gas Utilization in Farm Equipment, Ernest Fannin
Modern Analytical Distillation of Crude Petroleum, J. A. Lockwood, R. L. LeTourneau, Robert Matteson, and Frank Sipos
Spectrographic Analysis of New and Used Lubricating Oils, C. M. Gambrill, A. G. Gassmann, and W. R. O'Neill
Spectroscopic Determination of Vanadium in Residual Fuel Oils, J. W. Anderson and H. K. Hughes
Technical Classrooms, H. Dayton Wilde
Testing Used Lubricating Oils for Norma Pentane and Benzene Insolubles, J. S. Wiberley, R. K. Siegfriedt, and L. J. DiPaola
The Determination of Oil in Refinery Waste Waters—A Benzene Extraction-Semi Micro Method, A. F. S. Musante
The Fundamentals and Performance of Gravity Separation—A Literature Review, Alfred C. Ingersoll
The Infrared Spectra and Structures of Paraffins, Olefins, and Alkyl Aromatics, H. L. McMurry, and Vernon Thornton
The Polarographic Determination of Dissolved Oxygen in Petroleum Fractions, Maynard E. Hall
The Propane Story, Robert S. Lee
The Quenched Electrode Procedure in Spectrographic Analysis, Ralph O. Clark, E. L. Baldeschwieler, C. M. Gambrill, C. E. Headington, Harry Levin, J. M. Powers and J. B. Rather, Jr.
The Relative Economics of LPG, Gasoline, and Diesel Fuel in Trucks and Buses, Eugene S. Corner and E. H. Berg
Use of Aluminum in Petroleum Refinery Equipment, E. E. Kerns and W. E. Baker

Annual Spring Meeting
Pacific Coast District
Biltmore Hotel
Los Angeles, California
May 10-11, 1951

A Review of Casing String Design Principles and Practice, J. O. Hills
Investigation of Torque Converter Drives on Mud Pumps E. G. Chilton and D. F. Toomey
K-Monel Non-Magnetic Drill Collars for Oil Well Surveying, R. I. Mahan
Our Future Around the World, Henry J. Taylor
Prediction of Corrosion in Oil and Gas Wells, D. H. Shock and J. D. Sudbury
Production Performance and Preliminary Results of Gas Injection, 27 B Pool Unit, Buena Vista Hills, E. W. Brubaker and H. J. Stutsman
Rubber, Its Properties and Applications to the Drilling Industry, Joseph B. Larkin
The Effects of Mud Filtrate and Mud Particles Upon the Permeabilities of Cores, R. F. Krueger and T. J. Nowak
The Effort That Finds Oil, Frank A. Morgan
Water Drive Reservoir Performance, Vedder Pool, Wasco Field, N. van Wingen

American Society of Mining and Metallurgical Engineers

Semi-Annual Meeting
St. Louis, Missouri
June 19-23, 1950

Extraction and Refining of Shale Oil, Boyd Guthrie and Lester Schramm
Gas Turbine Combustors for Gaseous Fuels, A. E. Hershey and K. L. Rieke
Metals for High-Pressure Hydrogenation Plants, G. A. Nelson
New Method for Bulk Modulus Determinations, S. Logan Kerr, Lewis H. Kessler, and Merrill B. Gamet
Oil-Shale Mining, E. D. Gardner and E. M. Sipprelle

Annual Petroleum Mechanical Engineers Conference
Roosevelt Hotel
New Orleans, Louisiana
September 24-28, 1950

Allowable Loads on an Unsupported Casing Column, J. A. Reed, II, and H. H. Meredith, Jr.
A Portable Automatic Sampler, W. E. Roads
A Review of the Factors to be Considered in the Selection and Maintenance of Diesel Engine Lubricating Oils, E. B. Rawlins
A Standard Laboratory Corrosion Test for Material in Phosphoric Acid Service, M. A. Scheil and H. F. Ebling
Corrosion in Amine Plants, C. L. Blohm and F. C. Riesenfeld
Corrosion of Alloys at High Temperatures with Especial Reference to Attach by V_2O_5, R. A. Koslik and E. M. Skinner
Crank Case Explosions, F. V. Cook
Design and Development of Mechanical Seals, L. L. Dawson
Design of High Strength Casing Strings, B. E. Curran
Design of Hydraulic Pumping Equipment, P. J. Donnelly
Discussion of Pipe Line Sampling, F. H. Warren
Discussion of Surge Problems, S. Logan Kerr
Effect of Time on Physical Properties of Tanks, T. L. White
Fatigue Testing and Development of Drill Pipe-To-Tool Joint Connections, W. S. Bachman
Gas Propulsion as Applied Today to Oil Production, D. G. Knox
Instruments for Pipe Line Pressure Surge Studies, F. O. Stivers
Lubricated Plug Valves for Drilling and Well-Head Service, E. E. Hedene
Lubrication of Refinery Equipment, F. M. Leverett
Modern Practices in Off-Shore Drilling, A. F. T. Seale
Oil Industry Gaskets, H. H. Dunkle
Operating Experience With the Coal-Hydrogenation Demonstration Plant, C. C. Chaffee and E. A. Clarke
Operation of Submarine Pipe Line and Production Facilities in the Gulf of Mexico, G. W. Osborne
Pipe Line Engine and Compressor Lubrication and Maintenance, O. H. Moore
Preparation of Synthetic-Fuel Cost Estimates by the Coal-To-Oil Demonstration Branch, L. C. Skinner
Properties and Applications of Ductile Cast Iron, M. Kuniansky
Protection of Structures Exposed to Sea Water, B. B. Morton
Refinery Lubrication—A Management Problem, L. F. Jahnke
Steam and Power Plant Economy and Capability at Louisiana Station, R. J. Robertson and W. B. Gurney
Study of 9% Nickel Tubing in Corrosive Condensate Wells, L. W. Vollmer and C. N. Bowers
The Bassinger Rotary Percussion Drill, Robinson Brown
The Bureau of Mines Gas-Synthesis Demonstration Plant at Louisiana, Missouri, R. G. Dressler and J. R. Bircher
The Effect of Patents on Petroleum Production and Development, Paul F. Hawley
Welding Quality Control in a Petroleum Refinery, A. F. Blumer
Well Performance in Relation to Gas Transmission Line Requirements, E. R. Phillips

Annual Meeting
Hotel Statler
New York, N. Y.
November 26—December 1, 1950

A Leak-Proof Heat Exchanger, J. T. Cullen
Aluminum Alloys in Heat-Exchanger Construction, E. G. Kort and J. S. Hamilton
Heat Transfer (VII)—Applied Mechanics (VIII) Expansion Joints for Heat Exchangers, M. F. Sayre, S. Kopp, and C. L. Bulow
Heat Transfer to a Fluid Flowing Turbulently in a Smooth Pipe With Walls at Constant Temperature, R. A. Seban
High-Pressure Compression-Ignition Engine-Turbine Cycles, R. A. Harmon
Precision and Accuracy of Orifice-Meter Installations, L. V. Cunningham, Jr.
Some Industrial Experiences With Synthetic Lubricants, C. H. Sweatt and T. W. Langer
Theory of the Oil Cooler: Heat Exchange and Pressure Drop in Slots With Parallel Walls at Variable Viscosities, H. Schuh

LAUGH with BARNEY

A man who was fond of playing practical jokes, sent a friend a telegram, charges collect, which read: "I am perfectly well."

About a week later, the joker received a heavy package on which he was required to pay a large express charge. Opening it he found a big block of concrete on which was pasted this message: "This is the weight your telegram lifted from my mind."

* * *

Happy Young Fiancee: Darling, when we are married, I am going to cook and darn all your socks.

He: Oh, that won't be necessary, dear: Just darn them!

* * *

Bus conductor, calling from the upper deck: Is there a mackintosh down there big enough to keep two young ladies warm?

Voice from below: No, but there's a MacPherson that's willing to try.

* * *

Boss to secretary: Make about 20 copies of that, Miss Ross, so we'll run across one when we need it.

* * *

Many of us are at the "Metallic" age —gold in our teeth, silver in our hair . . . and lead in our pants.

A merchant took out a fire insurance policy and the same day his store and its contents burned to the ground. The insurance company suspected fraud, but couldn't prove anything. It had to content itself with writing the following letter:

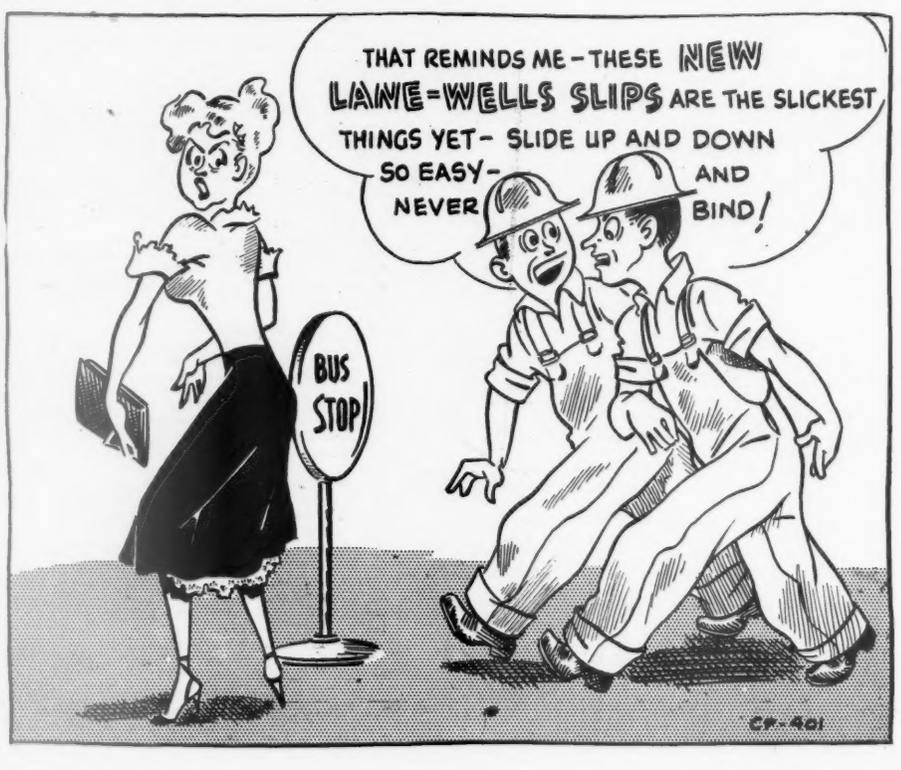
Dear Sir:

You took out an insurance policy at 10:00 a.m. and your fire did not break out until 3:30 p.m. Will you kindly explain the delay?

* * *

A number of men, not too well known to each other and meeting as a group for the first time, thought each should introduce himself by giving his full name, education, family status, and so on. The first gentleman started by saying he was Alexander Swinefurt MacGibbon, Harvard '19, married, with two sons; both at Harvard. The second said he was Theodore Spotswood Burlingame, Jr., Harvard '15, married, three sons—all Harvard, of course. The third said he was Percival Bollingbrooke Timberland III, Harvard '18, married, two sons—both Harvard, of course.

The next man rose and stated, "I'm Bill Jones, Yale '20. I'm not married. I have two sons—both Harvard, of course."


THAT REMINDS ME - THESE NEW LANE-WELLS SLIPS ARE THE SLICKEST THINGS YET - SLIDE UP AND DOWN SO EASY - AND NEVER BIND!
BUS STOP
CP-401

Sandy McTavish climbed on the bus carrying a heavy sack. The conductor told him that he would have to pay double fare, as the sack was so large it took up a whole seat.

Sandy thereupon opened the sack and called: "Jack, you'd better come out and pay your own fare."

* * *

Visiting Delegate (to hotel clerk): Why didn't you call me at 7:30 this morning?

Clerk (politely): Because you didn't go to bed till eight.

* * *

A southerner, with the intense love for his own section of the country, attended a banquet. The next day a friend asked him who was present. With a reminiscent smile he replied: "An elegant gentleman from Virginia, a gentleman from Kentucky, a man from Ohio, a bounder from Chicago, a fellow from New York, and a galoot from Maine.

* * *

Customer: Remember that cheese you sold me yesterday?

Grocer: Yes, madam.

Customer: Did you say it was imported or deported from Switzerland?

* * *

John was explaining why he always got up for a lady standing in a bus. Said he:

"Ever since I was a kid I've had a lot of respect for a woman with a strap in her hand."

* * *

The office of a certain small and none too successful produce concern down in Alabama is painfully cramped by reason of a huge old-fashioned iron safe which occupies nearly half of the tiny cubicle.

The other day a curious friend of one of the partners inquired: "Jake, what in the world do you keep in such a large strongbox,"

"Not much," Jake admitted; "two account books and my partner's pearl-handled pistol."

"Then," demanded the other, "why in heaven's name have you got such a large one?"

The produce merchant leaned over, and with the air of a small boy confiding a delicious secret, whispered: "Helps the morale of the creditors!"

* * *

"How'd you get along in that fight with your wife, the other night?"

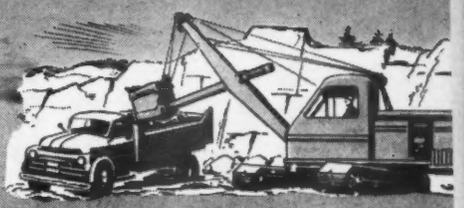
"Aw, she came crawling to me on her knees."

"Yeah, what did she say?"

"Come out from under that bed, you coward."

WHATEVER THE JOB...

Chrysler Industrial Engines give Better Performance at Lower Cost!



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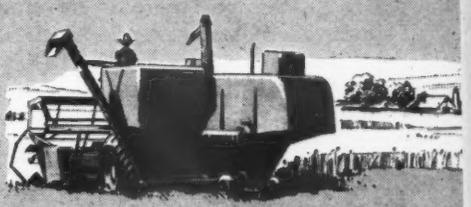
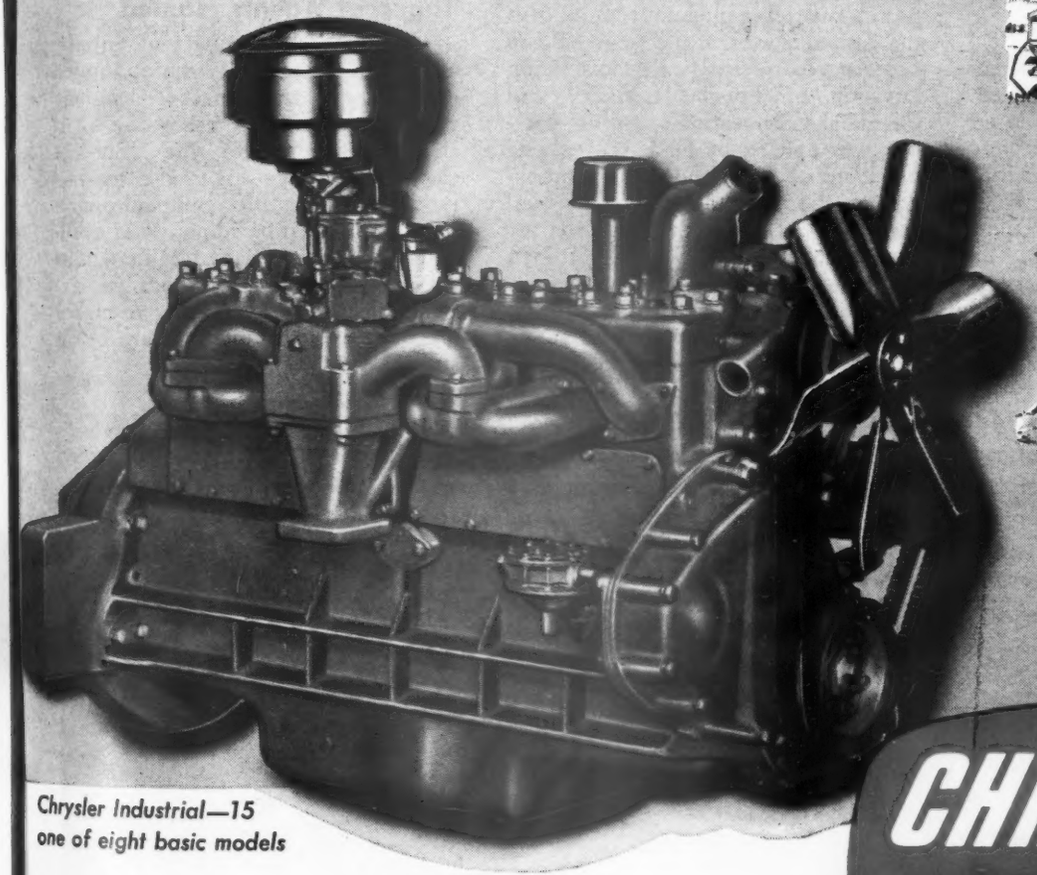
Ditching Machines • Cranes • Truck Mixers • Shovels • Loaders • Yarders Concrete Mixers • Road Pavers Crane Carriers • Scoop Tractors

In Industry, Chrysler Powers
Air Compressors • Hoists • Derricks Pumps • Generators • Tractors • Arc Welders • Baling Machines • Conveyors • Tackle Blocks • Winches



In Farming, Chrysler Powers
Tractors • Combines • Gang Mowers Spreaders • Irrigation Equipment Orchard Sprayers • Hay Choppers Pumps • Feed Mills • Sprinklers

In Other Fields, Chrysler Powers
Locomotives • Motor Coaches • Drilling Equipment • Air Conditioning Equipment • Pulp Machines • Fire Pumps • Street Flushers • Snow Plows • Oil Well Pumps and Drillers



Chrysler Industrial—15
one of eight basic models

Leading manufacturers and operators of industrial equipment are unanimous in their praise of Chrysler Industrial Engines.

For Chrysler Industrial Engines are designed and built specifically for rugged work. They are engineered to develop maximum power day-in, day-out with a minimum of down time and at a minimum operating cost. They are not only capable of wide application but they can also be adapted to specific regional operating conditions.

Chrysler Industrial Engines are backed by service everywhere.

A letter of inquiry will bring an engineer well qualified to discuss your application. Address: **Industrial Engine Division, The Chrysler Corporation, Detroit 31, Michigan.**

CHRYSLER

HORSEPOWER WITH A PEDIGREE

OIL AND GAS TRADE NEWS

Cinch Pipeline Succeeds Coody Bender Company

Cinch Pipeline Equipment, Inc., of Houston is successor to the Coody Bender Company, originators of the machine for creating smooth uniform bends on big-inch pipe line construction. The company is now engaged in manufacturing, selling, renting, and servicing the Cinch bender, which was introduced to the pipe line construction industry two years ago, as well as the Cinch hydraulic outside line-up clamp. Paul Barkley, president of the new organization, was vice president and general manager of Coody for more than a year. Although the company name has been changed and has moved into its new plant at 7050 Long Drive, Houston, there is no change in the shop or service personnel.

A. O. Smith To Sell Hughes Carburetor

A. O. Smith Corporation has entered the LPG carburetion business. Arrangements have been completed with the Hughes Carburetor Company of Oklahoma City for A. O. Smith to acquire manufacturing and sales rights for an LPG carburetion adapter unit developed by L. L. Hughes. The carburetor has the feature of permitting the existing gasoline fuel system to be retained on the vehicle, providing LPG carburetion as an alternate.

Harbison Will Head New Philco Office

Because of expanding activities in Government and industrial work in cooperation with aircraft and other manufacturers on the Pacific Coast, the Government and Industrial Division of Philco Corporation is establishing an office in Beverly Hills, California, with Edward F. Harbison as manager. The new office will be the headquarters for contacts on the Pacific Coast on such phases of the national security program as guided missiles, torpedoes, radar, and associated electronic devices.

Peerless Pump Men Meet

Plans under which Peerless pump sales for 1951 can exceed the sales and service records set in the previous year, were laid down for the company's district managers from all over the United States, at meetings held in Los Angeles recently. Peerless Pump Division of Food Machinery and Chemical Corporation's annual meeting, was opened by G. F. Twist, vice president of FMC and general manager of the Peerless pump division. Twist gave a brief resume of the accomplishments of 1950 and outlined the strategy for the current sales year. Enthusiastic support of the general program, which was developed at the meeting, was a feature of the session.

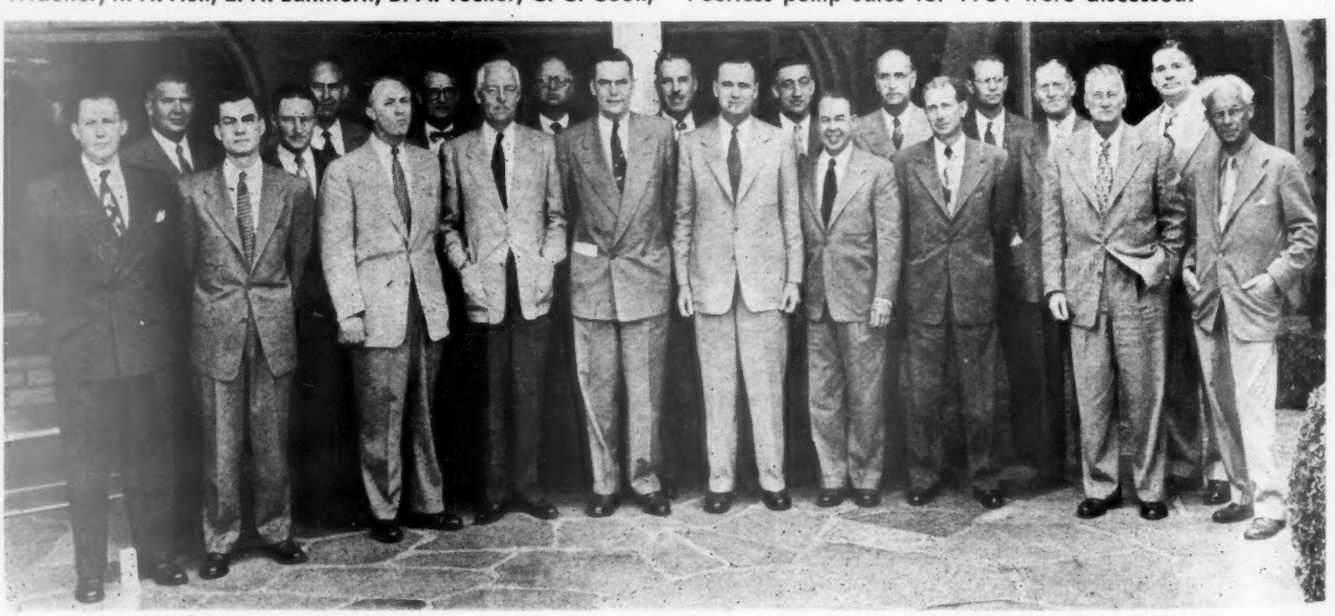
Allis Chalmers To Make Jet Engine Compressors

The largest subcontract yet signed in the Curtis-Wright Corporation's defense expansion program was announced recently—a multi-million dollar order to Allis-Chalmers Manufacturing Company for the Wright J65 sapphire turbo jet aircraft engine. Allis-Chalmers will shortly begin construction of a new plant for the manufacture of compressors for the Wright Sapphire, an engine of 7200 lb thrust, which powers the Republic F84F thunder jet fighter. The new plant, which will cost some $5,000,000, will be built in Terre Haute, Indiana. First shipments are to be made by December of this year, the company reported. About 400,000 sq ft will be available in the building.

Tapecoat Agents Named

Middle West Coating and Supply, Tulsa, Oklahoma, has been appointed distributor by the Tapecoat Company of Evanston, Illinois, according to Al Bohne, president of the Tapecoat Company. Tapecoat is used extensively by gas and utility companies as a protection for pipe joints. It is available in 2, 3, 4, 6, 18, and 24 in. widths for use on all sizes of pipe. The extreme flexibility of Tapecoat makes it especially adaptable to sharp bends and joints.

District Managers Annual Meeting. Attending the Peerless Pump Division's annual meeting in Los Angeles recently are: J. F. Van Dam, E. H. Hanse, R. F. Foster, F. D. Widener, R. H. Hull, E. H. Lanthorn, B. A. Tucker, C. C. Cook, W. E. Griffin, G. D. Sickert, F. W. McCann, G. F. Twist, C. L. Nickel, J. C. Bonsall, J. H. Raths, V. L. Ray, C. H. Sorter, A. F. Barron, E. W. Lundy, S. M. Riordan, and J. B. Downie. Peerless pump sales for 1951 were discussed.



Schlumberger Well Surveying men attend conference in Houston, Texas.

B. S. & B. Plan Expansion

Plans for a major expansion of the Oklahoma City plant of Black, Sivalls and Bryson, Inc., were announced recently by K. W. Lineberry, president. The announcement was made at a dinner meeting of regional, branch, and sales personnel of the oil and gas sales division of the company. The program, to begin immediately and to be completed within the year, will increase the Oklahoma City plant's productive output 50 per cent and should increase the number of productive workers about 25 per cent. Lineberry also announced the moving of the oil and gas equipment division of the company, including engineering and sales staffs, to Oklahoma City where the company's oil field equipment is fabricated and distributed. Approximately 25 engineers and supervisors will be transferred immediately from the general offices in Kansas City, to Oklahoma City.

Industry-Wide Conference On Well Logging Held

The second in a series of industry-wide conferences in well logging was conducted by Schlumberger Well Surveying Corporation recently at Houston, Texas. Those attending came from oil regions throughout the United States, Canada, and South America. The conference included study sessions on the basic electrical log, qualitative, and quantitative interpretations of sand-shale and limestone reservoirs; use of the "Micro-Log," Laterolog, Gamma Ray, and other auxiliary services. Individual problems of the visiting group were discussed with the Schlumberger technical staff.

Those attending the second meeting are shown in the accompanying photo. They are, l to r, front row: C. H. Blackburn, Alice, Texas; J. T. Foster, Pharr, Texas; R. J. Yakupzack, Houma, Louisiana; J. A. Williams, Harvey, Louisiana; B. R. Leeds, Lloydminster, Canada; E. D. Haymon, New Orleans, Louisiana; G. H. Fentress, El Dorado, Arkansas; R. B. Benway, Tulsa, Oklahoma; J. A. Maurer, Duncan, Oklahoma; B. F. Patterson, Jr., Shreveport, Louisiana; W. D. Fugler, Jr., New Orleans, Louisiana; O. D. Stevens, Jr., Tulsa, Oklahoma; Leroy Gideon, Ft. Worth, Texas; John D. Henderson, Midland, Texas; C. J. Cunningham, Wichita Falls, Texas; W. B. Junod, Beaumont, Texas; R. E. Lee, Beaumont, Texas; M. P. Tixier, Houston, Texas.

Second row, P. E. Reynard, Mexico; W. E. Harkness, Jr., Liberty, Texas; Chet Doyle, Taft, California; A. H. Curren, Long Beach, California; J. P. Byrne, Opelousas, Louisiana; W. D. Ford, Oklahoma City, Oklahoma; D. M. Quillan, Midland, Texas; Will H. Knight, Jackson, Mississippi; E. H. Culbertson, Eastland, Texas; R. M. Caywood, Oklahoma City, Oklahoma; Rush George, Gaines-

Black, Sivalls and Bryson plant in Oklahoma City, Oklahoma.

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the Complete Line of
R·P&C VALVES

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Bronze
Globe
Valve

When you choose R-P&C Valves, you can be sure of the same high quality of each one—from tiny ⅛" valves . . . to high-pressure, high-heat valves . . . and giant valves for handling huge volumes of liquids.

- You can get bronze, iron, steel—bar stock—iron cocks—and cast steel fittings. Two new numbers are PRESSURE SEAL BONNET and FORGED STEEL GATE. New ones coming.
- Call your local R-P&C distributor today or write the nearest R-P&C district office.

ACCO
Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

"Intentionally Better"
READING-PRATT & CADY VALVES

ville, Texas; E. W. Sengel, Liberal, Kansas; C. D. Jones, Midland, Texas; A. L. Richards, Bartlesville, Oklahoma; Charles E. Phillips, Houston, Texas; G. P. Stringer, Russell, Kansas; T. C. Cash, Tyler, Texas; A. M. Allegret, Houston, Texas.

Third row, J. A. Ricard, Peru, C. D. McMurrey, Houston, Texas; R. M. Chatham, Jr., Beaumont, Texas; L. C. Schmidt, Flora, Illinois; M. B. Morris, Corpus Christi, Texas; D. G. Swiers, Coalinga, California; F. M. Purcell, Houston, Texas; R. E. Hamilton, Lubbock, Texas; D. E. Edstrom, Casper, Wyoming; W. M. Pickles, Houston, Texas; E. S. Scholl, Bradford, Pennsylvania; P. Gaines, Tyler, Texas; E. M. Gurnea, Shreveport, Louisiana; R. C. Hagens, Corpus Christi, Texas; J. M. Gibson, Russell, Kansas; George M. Yoder, Laurel, Mississippi; John D. Mullins, Lake Charles, La.; C. G. Koe, Houston, Texas; R. R. Dutka, Calgary, Canada.

Fly to The Hague. Jack Long, right, assistant general manager of Oil Base, Inc., says goodby to Doyne Wilson, center, and George Miller, left, who are attending the Third World Petroleum Congress in The Hague. Miller, Oil Base president, has prepared a paper on oil base drilling fluids, and Wilson, director of research, a paper on oil emulsion muds.

Cleco Office Moved

Cleco division of the Reed Roller Bit Company, Houston, Texas, has moved its Philadelphia office to 5200 North Fifth Street, Philadelphia 20, Pennsylvania. The Cleco and Dallett lines of pneumatic tools include tools for construction, manufacturing, metal fabrication, foundries, industrial maintenance, and stone carving.

National Supply's New Mexico store.

Grancell plant completed.

National Supply Adds New Mexico Store

Announcement has been made by The National Supply Company Toledo, Ohio, of the recent opening of a new store at Farmington, New Mexico. The Farmington store will stock rotary machinery, equipment, and parts necessary for operations in the Farmington area, primarily a gas-producing district. A limited stock of cable tool and well head equipment will also be carried. C. W. Morris will manage the store, which will serve Southwestern Colorado; San Juan County in Utah; and McKinley, Rio Arriba, San Juan, Taos, Colfax counties in New Mexico. He will be assisted by Malcolm "Mike" Hart, field salesman; Mrs. Margaret M. Budd, clerk-stenographer; and Edmund E. Lenfestey, warehouseman.

Grancell Plant Completed

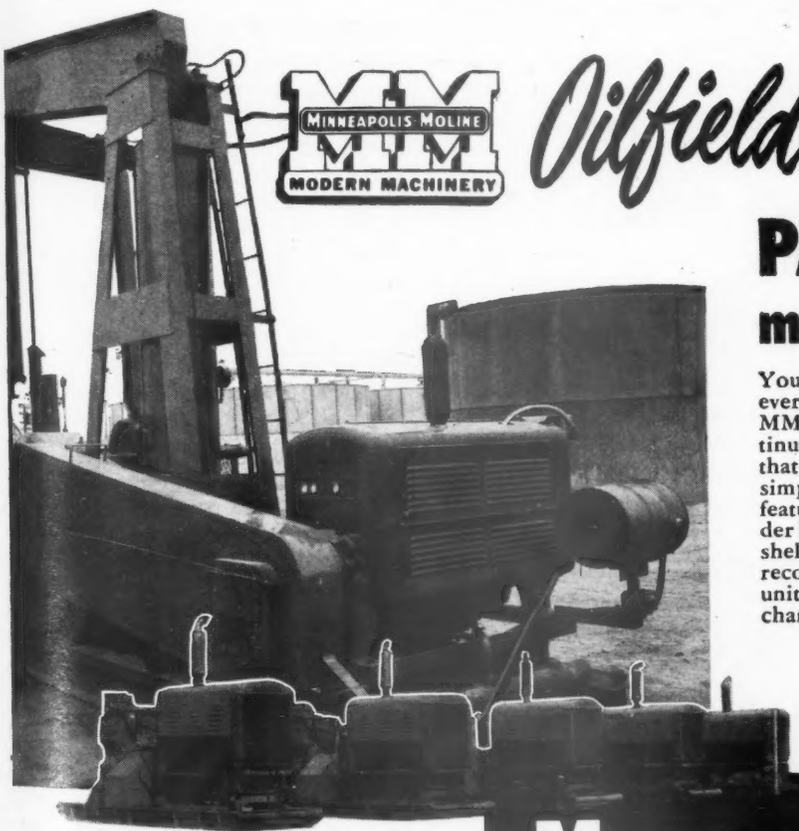
I. H. Grancell, Los Angeles, California, manufacturers of 'Bestolife lead seal pipe joint compounds, have just completed construction of their new plant at 1601 East Nadeau Street in Los Angeles. The new plant was built entirely over the old plant. Production and office activities continued all during the construction, the old building being torn down and moved as the new structure was erected around it. The plant occupies 9400 sq ft of floor space.

Binks Adds Pump Division

The Binks Manufacturing Company, Chicago, Illinois, makers of spray painting and finishing equipment, has added a pump division. This division, which deals primarily with material handling pumps, enables Binks to offer users of spray finishing equipment a more complete line from one source. Burke B. Roche, president, announces that Karl W. Osterstrom—a specialist in the design and development of air-operated hydraulic pumps—has been appointed manager of the new pump division.

Greer Appoints Agents

Greer Hydraulics, Inc., announces the appointment of the J. M. Grimstad Company as sales and service representative for the Minnesota and Northwestern Wisconsin area. Robert Hazelrigg, with headquarters at the Minneapolis office at 2509 30th Avenue South, will be in charge of sales and service of Greer products as including hydraulic accumulators, filters, valves, and other hydraulic system components for industrial use.



MINNEAPOLIS-MOLINE MM MODERN MACHINERY

Oilfield POWER

PAYS YOU in longer, more efficient service!

You don't pay extra for the years of experience built into every Minneapolis-Moline Power Unit . . . *It Pays You.* MM Oilfield Engines are designed for heavy-duty, continuous operation PLUS a standardized engine design that makes maintenance and service work an amazingly simple job. For example, consider the service economy features in the exclusive MM designed removable cylinder heads and blocks cast in pairs and the precision steel-shell bearings. These two features alone mean low-cost reconditioning or replacement. 4, 6 and 12 cylinder units are identical in design and most parts are interchangeable for easier, low-cost service.

MM engines have an enviable record of continuous duty without mechanical shutdown and are available in 7 sizes from 25 to 180 hp. Only MM Oilfield Engines have built-in Heat Exchanger Base Pans to give you lowest field maintenance!

Distributed by SHRIMPTON MANUFACTURING AND SUPPLY CO. . . . Los Angeles, California; Oklahoma City, Oklahoma; Kilgore, Texas

MINNEAPOLIS-MOLINE
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Flame Arrestors

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DEPENDABLE
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● These arrestors combine the desired flame stoppage and explosion prevention with minimum pressure drop. Sturdy, rugged semi-steel housings and covers. Corrosion resistant aluminum "banks" have vertical straight through passages, minimizing clogging and simplifying inspection;— extensible for easy cleaning. 2" to 10" sizes. *Write for Bulletin No. 471-R. It gives full details.*

OCECO TANK FITTINGS
THE JOHNSTON & JENNINGS CO.
division of PETTIBONE MULLIKEN CORP.
4751 West Division St. • Chicago 51, Illinois

Durametallic Packing Wins Test Sealing 18 Solvents and Diluents

One of the nation's leading valve manufacturers recently conducted a thorough test on the corrosion resistant qualities of three leading brands of packing.

18 solvents and diluents were used in the test as follows: Butyl Acetate, Butyl Cellosolve, Cellosolve, Ethyl Acetate, Bensol Naphtha Med. Boil., Naphtha High Boil., Solvesso No. 2, Toluene, Xylol, Amyl Alcohol, Butyl Alcohol, Ethyl Alcohol, Isopropyl Alcohol, Methanol, Acetone, Methyl Ethyl Ketone and Methyl Isobutyl Ketone.

The packing that proved successful on this 90-day test, (having no leak or corrosion affecting operation), is indicated by the test engineer's report: "A valve suitable for handling solvents, diluents, paint and lacquer thinner should have the following stem packing—DURAMETALLIC NO. 777 NMT."

We will be glad to forward information on this or other types of Durametallic Packings for valve and pump requirements . . . simply write to the Durametallic Corporation, Kalamazoo, Michigan, for Bulletin No. PE-438.

Synchro-Master Joins %Proportioneers, Inc.%

%Proportioneers, Inc.%, Providence, Rhode Island, manufacturer of chemical proportioning and feeding equipment, has acquired Synchro-Master Company formerly of Seneca Falls, New York, and will operate the business as its Synchro-Master division with sales and production facilities in Providence. Key personnel of the Synchro-Master Company has also joined %Proportioneers% and will manage the new division. The standard Synchro-Master unit will now be manufactured by %Proportioneers, Inc.% and new designs are contemplated for use with the company's automatic proportioning and blending systems.

Hammond Grants Licenses To Lacy, Keyes Companies

Hammond Iron Works of Warren and Bristol, Pennsylvania, announces the licensing of Lacy Manufacturing Company of Los Angeles, California, and Keyes Tank and Supply Company of Casper, Wyoming and Provo, Utah, to fabricate and erect all designs of Hammond conservation storage tanks. These designs include the Hammond Dialift, Diaflote and Vaporlift tanks, as well as floating roof and pressure tanks.

Colorado Branch Set Up

McCullough Tool Company has established a new service branch in Sterling, Colorado. The Rocky Mountain district office will remain in Casper, Wyoming. The new service branch is situated at 210 North 2nd Street in Sterling. R. E. "Rusty" Hurst, formerly in the district office at Casper, has been appointed branch manager.

American Pipe to Use Tate Pipe Lining Process

To meet the growing need for uniform pipe lining service on both small and large diameter pipe throughout the country, the American Pipe Construction Company of Los Angeles has incorporated Pipe Linings, Inc. as a subsidiary company. Heretofore, large diameter pipes have been lined in the West by the Centriline Division of the American Pipe and Construction Company and the work will continue to be done by the Centriline Division.

Small diameter pipes have been lined for many years by Tate Pipe Linings, Inc., of Andover, Massachusetts. Tate Pipe Lingings, Inc. is in process of dissolution, and Pipe Linings, Inc. has acquired most of its equipment and some of its personnel.

British Firm To Make McEvoy Gate Valves

Under an agreement reached more than a year ago, the British manufacturing firm of Newman, Hender and Company, Ltd., Woodchester, England, this month begins production of an English version of the McEvoy gate valve, to be called the "Newman-McEvoy" valve. The McEvoy Company of Houston, Texas, issued this license to enable Newman, Hender to manufacture and distribute McEvoy gate valves for the oil production industry to sterling bloc markets throughout the world. Willard O. Hedrick, vice president in charge of production for the McEvoy Company, will go to Woodchester, England, to see the first valves made under the agreement.

W. O. Hedrick inspects valves.

Bascom Rope Factory Completed in Houston

Broderick and Bascom Rope Company has built a wire rope factory at 9350 Market Street Road in Houston. Covering 34,000 sq ft of floor space and equipped with the latest machinery, this local facility will mean faster service for customers in this territory who heretofore were supplied through the Houston warehouse.

Although the Houston factory has been in partial operation for the past several months, installation of all machinery is now complete and full production is under way. Practically all grades and constructions of wire rope, including the company's "Yellow Strand" grade are being manufactured. Laurence R. Saunders, who managed the company's Houston district sales office, has been appointed manager of an enlarged sales territory to be served by the Houston plant. Wilmer H. Wheeler is plant superintendent.

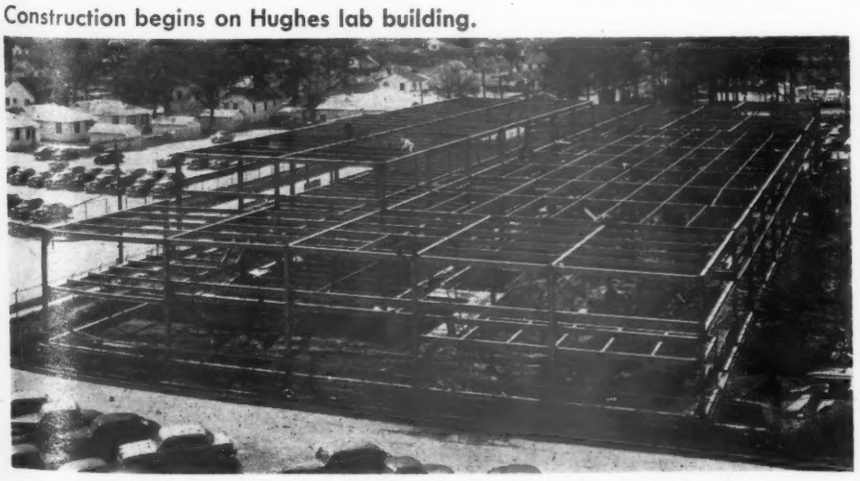
California Agents Named

The Heat Transfer Division of The National Radiator Company, Johnstown, Pennsylvania, announces the appointment of Jackson Engineering Company, Los Angeles, California, as its sales representative throughout Southern California. Gordon M. Jackson, a graduate of the U. S. Naval Academy, served in both wars, and during World War II was a Lieutenant Commander liaison officer between the Army-Navy Petroleum Board and the Petroleum Administration for War.

Hughes Erects Structure For Engineering Lab

Scheduled for completion by June of this year, construction of the Hughes Tool Company's new $2,000,000 engineering laboratories building is moving forward rapidly. The structural steel work has been completed. The new laboratories building, two stories in the center, covers 75,000 sq ft. When completed it will house the metallographic laboratory and offices, chemical laboratory, emission spectrum laboratory, projection room and library, welding laboratory, and machine shop, and testing section.

Construction begins on Hughes lab building.



More Accurate Level Reading of LOW TEMPERATURE LIQUIDS . . .

JERGUSON

Large Chamber

NON-FROSTING* GAGES

YOU get the highest possible accuracy of reading on low temperature, low boiling point liquids with the patented Jerguson Non-Frosting Gage in the New Large Chamber model . . . because it insures less turbulence at the meniscus, and clear vision at the vision slot.

This new Jerguson model has 6 times larger area at the meniscus than the standard gage, so that there is a marked reduction in turbulence with light gaseous fluids that tend to boil or surge. Moreover, the problem of frosting encountered with these liquids has been eliminated by a patented frost preventing unit extending from the gage glass. This special transparent unit projects beyond the cover bolts and prevents frost from building up over the vision slot.

Here's a dual feature gage that assures greatly increased accuracy of reading for the process industries. If you have a problem with light gaseous fluids, or with gage frosting, it will pay you to investigate the new Jerguson Large Chamber Non-Frosting Gage . . . reflex or transparent.

Jerguson Large Chamber Gage, Transparent Type, with the patented Non-Frosting Gage Glass Extension. Write for literature on this gage, and on other non-frosting Jerguson models.

**Patented*

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY

100 Fellsway, Somerville 45, Mass.

Representatives in Major Cities

Phone Listed Under JERGUSON

Jerguson Tress Gage & Valve Co. Ltd., London, Eng.

This DISASTER was born 18 months before it happened!

A year and a half before the axle snapped to cause this disastrous pile-up, a minute crack started. The axle *looked* all right during overhaul. It passed the eagle eyes of the inspectors. But this tiny, invisible crack grew larger and deeper in the thousands of miles—and 18 months of service. Finally—the axle gave way entirely, in a typical, progressive, fatigue failure.

Magnaflux would have prevented this, and *does* for hundreds of railroad, bus, truck, and airline operators. Magnaflux finds such defects in a wide variety of materials during manufacture and overhaul. It makes invisible cracks visible. Magnaflux is low in cost, non-destructive—*and so fast that it performs at production line speeds!*

For detailed information of how Magnaflux saves money and lives, write for literature, sent on request without obligation.

MAGNAFLUX

MAGNAFLUX CORPORATION
5918 Northwest Hwy., Chicago 31, Ill.
New York • Dallas • Detroit • Cleveland • Los Angeles

Oilfield Tank Men Form Association

A representative group of oilfield tank manufacturers met recently at the Mayo Hotel, Tulsa, Oklahoma, and organized the Oilfield Tank Manufacturer's Association. The purpose of

K. W. Lineberry

E. H. Zachariae

the Association is to promote the common interests of its members, with particular reference to steel allocation, work through and with the American Petroleum Institute towards standardization of products, and the gathering and dissemination of statistical data on quantity and kinds of products sold by the industry.

Offices have been established in the Tri State Insurance Building, Tulsa, Oklahoma. E. H. Zachariae has been appointed secretary and is the managing officer of the Association.

Officers and members of the executive committee elected for the ensuing year are: Kenneth W. Lineberry, president (president of Black, Sivalls and Bryson, Inc.), A. Sidney Knowles, vice president (president of Parkersburg Rig and Reel Company), Sam P. Wallace, treasurer (president of Maloney-Crawford Tank and Manufacturing Company), I. W. Lovelady (president, Sivalls Tanks, Inc.), and Cecil G. Wells (vice president of National Tank Company).

Glass Fibers Moves

Glass Fibers, Inc. has moved its offices to 1810 Madison Avenue, Toledo 2, Ohio. Administrative, sales and purchasing offices will be there.

Luse-Stevenson Is Agent

The Luse-Stevenson Company, Chicago, has been appointed distributor-applicator for Kaylo Heat Insulation by Owens-Illinois Glass Company in the Chicago area, it has been announced by W. M. Hankins, Jr., general sales manager of Owens-Illinois' Kaylo division. The Kaylo line of heat insulation includes heat insulating, block for flat surfaces, pipe covering for pipes and tubes from ¼ in. to 72 in. in diameter and vessels up to 60 ft in diameter. It is made of a chemical compound, called hydrous calcium silicate, which insulates effectively against temperatures all the way up to 1200 F. Principals in Luse-Stevenson are D. C. Luse, president; R. C. Fries, vice president and C. L. Cockrell, vice president.

Chemical Petroleum Division Set Up

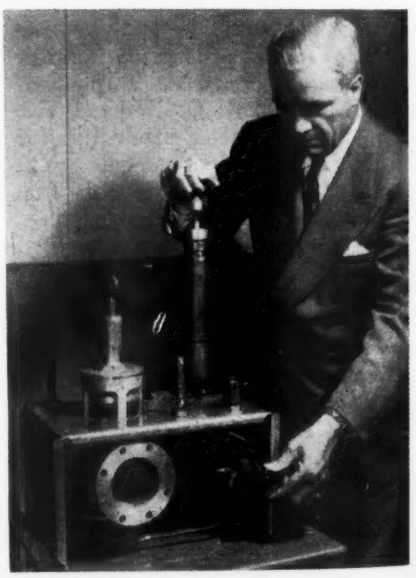
The National Airoil Burner Company of Philadelphia, Pennsylvania, has just announced the formation of its chemical and petroleum division. William Ferguson, vice president, heads the new division, which comprises a group of engineers widely versed in meeting the combustion, furnace, and related problems of the chemical and petroleum industries.

The technical staff of the chemical-petroleum division is under the direction of Frederic Bauer, chief technologist, who has been specializing in the chemical - petroleum industries' process heating problems for a major part of his career.

The mechanical engineering staff will be directly under the supervision of John J. Griffin, chief engineer.

Emergency Valve System

A working model of the new Fruehauf air emergency valve system for truck and trailer tanks is examined by



L. H. Thomas examines valve.

L. H. Thomas, manager of the tank division Fruehauf Trailer Company in the accompanying photo. Four automatic shut-off features, include 1. thawing of the fusible plug at 165 F dumps all air and valves close in case of fire; 2. an interference control valve assures valves are closed when traveling; 3. all valves close when a plunger is actuated by closing of can door; and 4. a leak in the system in case of accident closes valves—plus inability to wire the valves open—provide a heavy "plus" safety factor.

TRADE PERSONALS

J. J. Rozner J. E. Dillon C. E. Poehler H. V. Fox

▸ **J. J. Rozner,** formerly chief engineer and works manager, has been elected vice president in charge of operations of the Aetna Ball and Roller Bearing Company, Chicago, Illinois. He became chief engineer in 1940 and took over the added duties of works manager in 1948.

J. E. Dillon has been appointed to replace Rozner as chief engineer. Dillon joined Aetna 10 years ago as assistant metallurgist and was advanced to metallurgist in 1945. **C. E. Poehler** has been appointed assistant to plant superintendent **H. V. Fox.** Poehler, with the company 12 years, will, for the time being, continue to serve in his present capacity as tool room foreman as well as assistant to Fox.

▸ **J. Cameron Argetsinger** has tendered his resignation as vice president of The Youngstown Sheet and Tube Company, a position he had held for 15 years. Ill health during the last four years prompted his retirement from an official position with the company. He will continue, however, in a consulting capacity. He went to Cornell University where he received his B.A. and Bachelor of Laws degrees. In 1947 Youngstown College conferred on him the degree of Doctor of Laws in recognition of his outstanding civic work.

▸ **Walter C. Goza,** a veteran executive in industrial valve sales, has been named sales manager of the D. T. Williams Valve Company, a division of The Schaible Company. The announcement came from Michael Schaible, president, who said Goza's appointment is a major move toward expansion of the sales and production facilities of the 45-year-old Williams firm, which The Schaible Company has owned and operated since 1949. At the same time, Schaible disclosed modernization of the entire line of Williams bronze valves and fittings.

▸ **C. Benson Dushane, Jr.** has been elected vice president in charge of sales of the American Meter Company. Dushane attended Massachusetts Institute of Technology and Johns - Hopkins University. He joined the sales department of American Meter Company in 1920. Prior to his election as vice president, he was manager of the Mid-West sales division of the company, with offices in Chicago, Illinois.

C. B. Dushane, Jr.

John C. Diehl was elected chairman of the board, and **W. G. Hamilton, Jr.** was named president of the American Meter Company, Inc., producers of gas meters, regulators, and instruments. Diehl, who has been president since August, 1950, was previously vice president, and is the author of many technical books and articles. Hamilton has been with the company since 1927, and was previously vice president in charge of sales. **A. McBeath** was appointed controller; **E. J. Mowry** was appointed personnel director, and **L. F. McDonald,** traffic manager.

▸ **Carl L. Ipsen,** manager of General Electric's industrial heating divisions at Schenectady, New York, has relinquished his duties in order to accept a position in an advisory capacity to the machinery division of the National Production Authority. In his absence, Ipsen's responsibilities will be assumed by **E. W. Cunningham,** who has been named acting manager of the industrial heating divisions.

The 1951 annual meeting of the Rector Well Equipment Company, Inc. was the first to be held in the company's new home office building at Fort Worth, Texas. Attending the meeting were, front row, seated: Virginia Flowers, Minette Ross, Winifred Roberts, Carmen Hudson, L. L. Rector, W. P. Knight, R. V. Evridge, and R. M. White. Standing, first row: G. H. Stewart, Don C. Davis, F. D. Sewell, C. W. Zartman, W. M. Counts, A. J. LaBate, Marshall Kestler, B. V. Fisher, M. C. Davis, Wayne D. Smith, J. P. Bowling. Back Row: R. E. Sears, D. L. Tanner, C. L. Cron, E. W. Brockman, G. E. Milligan, M. T. Harrell, M. O. Andrews, J. L. Pinkard, G. S. Badger, and J. G. Brannon.

NEW from GARLOCK

Packings and Gaskets made of *Teflon**

*Teflon is the Du Pont Company's trademark for tetrafluoroethylene resin.

The Packing and Gasketing Material that

IS ENTIRELY UNAFFECTED BY ANY ACID, ORGANIC SOLVENT OR ALKALI SOLUTION

GARLOCK 8764 . . . *a rod, shaft or flange packing made of* Teflon *powder molded to required size and shape. Available in ring, sheet, gasket, tape, disc or cup form. Also used for making envelopes for gaskets.*

Exhaustive tests in the GARLOCK laboratories and in the field have proved that *Teflon* is the only *wholly* satisfactory material for sealing against acids, organic solvents, and other chemicals.

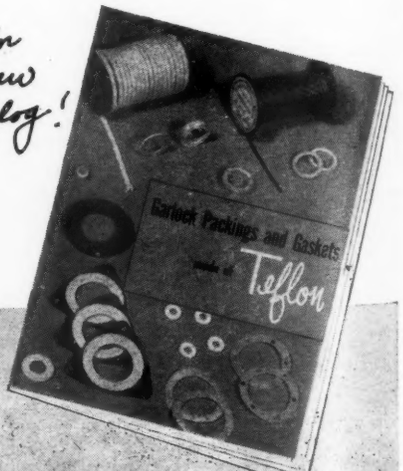
GARLOCK packings and gaskets made of *Teflon* are entirely unaffected by acids and are completely resistant to all organic solvents and alkali solutions. They are suitable for use at operating temperatures from below −90° F. up to 500° F. Within that temperature range these packings and gaskets *retain* their inherent toughness, have a *low* coefficient of friction, and do *not* react with metals of construction.

Wherever resistance to chemicals is a *requisite*, specify GARLOCK's *Teflon* packings for use on valves, pump rods or shafts and *Teflon* gaskets for all types of flanged joints.

GARLOCK 5733... *a "Lattice-Braid" rod or shaft packing made of* Teflon *filament. Supplied in coil or ring form.*

GARLOCK 9166... *a plastic rod or shaft packing made of shredded* Teflon. *Supplied in coil or ring form.*

Write for this new Catalog!



THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Tulsa, Okla. Houston, Texas Los Angeles, Calif.

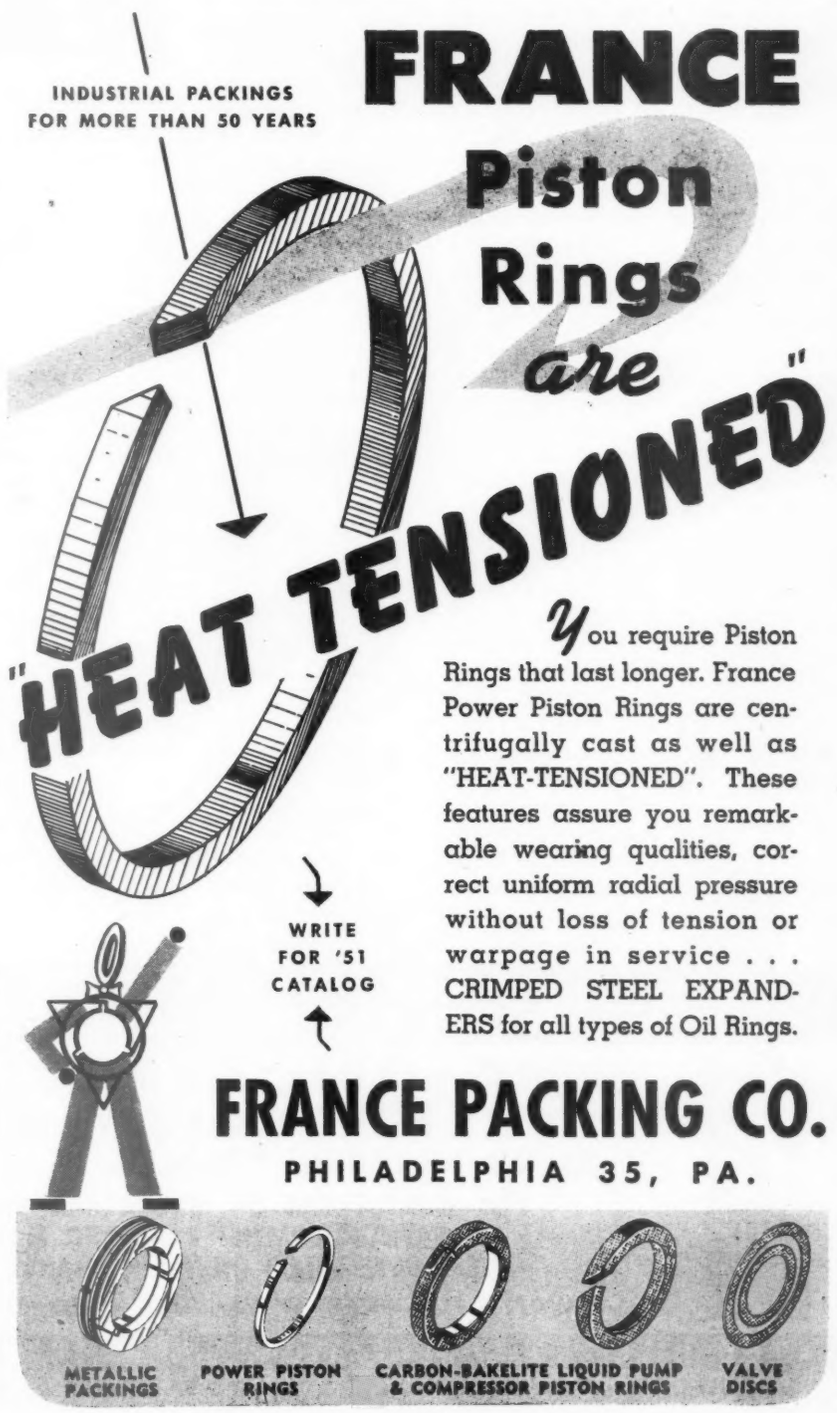
GARLOCK

P. Z. Hilliard | R. M. Flippo | T. P. Tarwater | W. W. Arnold | C. M. Fleeman

G. B. "Barney" Blair, has been promoted to the position of district manager for Mid-Continent Supply Company at Shreveport, Louisiana. Blair was made sales engineer at Denver, Colorado, in 1946. **W. M. "Pete" Day,** district manager at Natchez, Mississippi has been transferred to New Orleans as district manager. He succeeds **P. Z. Hilliard,** who was named management co-ordinator in the company's headquarters, Fort Worth, Texas. Day became district manager at Natchez in February 1949. Hilliard joined Mid-Continent in 1934.

R. M. Flippo, division machinery manager, Houston, Texas, has been promoted to manager of sales, machinery division, in the general offices, Fort Worth. He joined Mid-Continent in 1936. **J. W. Hoover** has been promoted from manager, engine division at Houston to division machinery manager. He has been with the company since 1936. **T. P. Tarwater** has been appointed general division manager of Mid-Continent. He was formerly manager of the company's West Texas-New Mexico division at Midland. **J. W. Eastham,** manager of the Mid-Continent field store at Odessa, Texas, was named district manager of the Brownfield-Synder-Sundown area.

James L. Waltrip has been named Fort Worth city salesman for Mid-Continent. Prior to this promotion, he had been manager of the machinery division quotations department. **R. E. Dunn,** recently became store manager at Sundown. He was formerly at Eunice, New Mexico, field salesman at Snyder, Texas. **W. W. "Woody" Arnold** has been appointed acting division manager of the West Texas-New Mexico division with headquarters in Midland. **C. M. "Mac" Fleeman,** district manager at Shreveport since 1949, has been promoted to division manager with headquarters in that city. **B. S. Harkrider,** store manager at Magnolia, Arkansas, since 1945, made store manager recently at the company's field store in Duncan, Oklahoma. **W. A. "Bill" Sellers,** former store manager at Mid-Continent's Sundown store, has been appointed manager of the company's store in Odessa. **R. P. "Randy" Brown** has been named store manager in Magnolia.


INDUSTRIAL PACKINGS
FOR MORE THAN 50 YEARS
FRANCE
Piston
Rings
are
"HEAT TENSIONED"
You require Piston Rings that last longer. France Power Piston Rings are centrifugally cast as well as "HEAT-TENSIONED". These features assure you remarkable wearing qualities, correct uniform radial pressure without loss of tension or warpage in service . . . CRIMPED STEEL EXPANDERS for all types of Oil Rings.
WRITE FOR '51 CATALOG
FRANCE PACKING CO.
PHILADELPHIA 35, PA.
METALLIC PACKINGS
POWER PISTON RINGS
CARBON-BAKELITE LIQUID PUMP & COMPRESSOR PISTON RINGS
VALVE DISCS

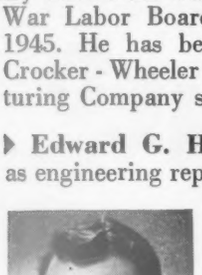
To obtain more information on products advertised see page E-45

▸ **R. E. F. Schmid,** Continental Supply Company, was elected president of the Dallas Purchasing Agents Association at a meeting held April 12. Schmid succeeds J. D. Brown, General American Oil Company. Other officers elected include **Frank Wodrich,** General Instruments, Inc., first vice president; **John Guynes,** Magnolia Petroleum Company, second vice president, and **Fred D. Bradley,** Southern Union Gas Company, secretary-treasurer. Schmid has been associated with Continental Supply for 30 years.

R. E. F. Schmid

▸ **Edward Barwell** has been named industrial relations coordinator of Worthington Pump and Machinery Corporation to assist **L. C. Ricketts,** vice president in charge of manufacturing. In making this announcement, Ricketts said Barwell would assist him in industrial relations and personnel policies. Barwell served on the Industry Tri-Partite Panel of the National War Labor Board from 1942 until 1945. He has been associated with Crocker - Wheeler Electric Manufacturing Company since 1926.

▸ **Edward G. Hall** was appointed as engineering representative for sales and engineering service department, Lenkurt Electric Company of San Carlos, California. Hall, prior to joining the Lenkurt Electric Company, had been for several years general transmission engineer for the Indiana Associated Telephone Corporation, Lafayette, Indiana.


E. G. Hall

▸ **Henry C. Morehouse,** father of Harry C. Morehouse, vice president of Wagner-Morehouse, Inc., Los Angeles, California, died recently. He was 85 years of age. A native of De Kalb, Illinois, Morehouse was a pioneer member of the Denver, Colorado city engineering department, from which he retired some 25 years ago.

▸ **Edward W. Johnson,** formerly manager of the centrifugal pump department of National Transit Pump and Machine Company, Oil City, Pennsylvania, has been named consultant on centrifugal pumps at Wilson - Snyder Manufacturing division of Oil Well Supply Company at Braddock. While with National Transit Johnson designed that company's Types E-S and C-S chemical, processing and general service centrifugal pumps, ranging in size from 1 by 1½ by 6 in. to 6 by 8 by 10½ in. Johnson joined "Oilwell" in October, 1950.

E. W. Johnson

▸ **Norman A. Strang** has been appointed advertising manager of SKF Industries, Inc., Philadelphia manufacturers of ball and roller bearings. He succeeds Robert C. Byler, who died recently from a heart attack.

N. A. Strang

Born in Pleasantville, New Jersey, on December 10, 1910, Strang was educated in Philadelphia, Pennsylvania. He was employed in an advertising capacity for John Lucas and Company, Roberts & Mander Stove Company, and Sun Oil Company, all of Philadelphia. He joined SKF in 1940.

▸ **F. E. "Dusty" Rhoades** has been named to head Happy Company's sales and service activities in the Oklahoma and Texas Panhandle territory with headquarters in Pampa, Texas. Rhoades has been in charge of sales and service in the Indiana and Illinois division for the past three and one half years.

F. E. Rhoades

Hayden O. Parent, former store manager at Salem, Illinois, has been named to succeed Rhoades.

▸ **Hugo J. De La Croix** and **W. D. Calhoun** have been appointed assistant supervisors of industrial relations for the Youngstown district of The Youngstown Sheet and Tube Company. Both have been assistants to the supervisor of industrial relations. De La Croix joined the company in November, 1945, and Calhoun joined one year later.

Frank Senzik has been appointed assistant superintendent of construction for the Youngstown district. He received his bachelor of science degree in civil engineering from Ohio University. He joined Youngstown Sheet and Tube in 1941.

▸ **Fred H. Angier** has been named as the new district manager for the Philadelphia and Baltimore factory branch offices of General Controls Company. Angier, who moves from the position of branch manager in Baltimore to his new post, will include in his territory the district of Columbia, Maryland, Virginia, West Virginia, eastern Pennsylvania, lower New Jersey, and Delaware.

F. H. Angier

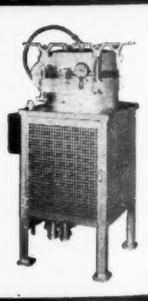
HILCO LUBE AND FUEL OIL PURIFICATION FOR DIESEL AND GAS ENGINES . . .

PURIFIERS · FILTERS · RECLAIMERS · CONDITIONERS

THERE'S A HILCO FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM . . .

YOU WANT CLEAN OIL AND CLEAN ENGINES TO SAVE EQUIPMENT - OIL AND MONEY - INVESTIGATE HILCO OIL MAINTENANCE METHODS

★ *WRITE FOR FREE LITERATURE - NO OBLIGATION*



• THE HILLIARD CORPORATION, 209 W. FOURTH ST., ELMIRA, N. Y. •

IN CANADA — UPTON-BRADEEN-JAMES, LTD. — 990 BAY STREET, TORONTO, 3464 PARK AVE., MONTREAL

Charles T. Reichert, division sales manager of The National Supply Company's oil field machinery and equipment division, at Torrance, California, has taken leave of absence to accept a post with the Petroleum Administration for Defense. Reichert has been named chief of the drilling and production section of the material division of PAD, charged with determining the material required to drill the 43,400 new wells planned by the petroleum industry in 1951. The division will also determine the material requirements of the nation's present 500,000 oil and gas wells. Following that, the division will allocate materials to the various equipment manufacturers and oil companies.

C. T. Reichert

Robert C. Tierney, formerly co-ordinator in the vertical turbine pump division of Worthington Pump and Machinery Corporation at Harrison, New Jersey, will be in charge of the corporation's new vertical turbine pump plant at Succasunna, New Jersey when it is completed. This was announced by L. C. Ricketts, vice president in charge of manufacturing. After attending Newark Technical School, Tierney joined Worthington in 1935 at which time he was engaged in general shop work. A year later he joined Worthington's engineering division at Harrison and in 1948 he became co-ordinator in the vertical pump division.

T. A. Nilsen, De Laval Steam Turbine Company, has been named district manager of a new Texas district office recently opened in the Esperson Building, Houston. **A. N. Sarich,** for several years the De Laval Southwest technical representative in Oklahoma and Texas will continue in the same capacity with headquarters in the new Houston office.

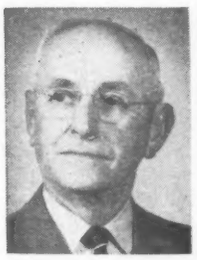
T. A. Nilsen

De Laval Steam Turbine Company has long been associated with Texas industry with centrifugal blowers for catalytic cracking plants, mechanical drive steam turbines for refineries and process plants, centrifugal pumps for all services, IMO rotary pumps for many oil handling services, and power transmission equipment.

Frank L. Orr, vice president and sales manager for the Maxim Silencer Company of Hartford, Connecticut, died in Washington, D. C., recently while on a business trip. He was with the diesel engine division of Fairbanks-Morse and Company after World War I and in November 1930 joined The Maxim Silencer Company.

L. B. McKnight has been elected to the newly created position of executive vice president of Chain Belt Company. McKnight has served in various managerial capacities since joining the company in 1927 and has been a vice president and director since 1948. He is currently president of the National Association of Conveyor Equipment Manufacturers and is also a member of the Conveyor Industry Advisory Committee to the National Production Authority.

John Augsberger has joined the perforated sales department of Kobe, Inc., according to a recent announcement made by J. J. Siegel, Kobe's manager of perforated sales. This addition to Kobe's perforated sales staff marks the first step in the company's soon-to-be-announced plans for expansion. Augsberger brings to his new position a wealth of experience in the petroleum industry, dating from his first job as a roustabout in 1930.



John Augsberger

Charles D. Corey has been made President of Air Clocks, Inc., Huntington Station, New York, a new company that has been established to manufacture a line of air-powered timing mechanisms. Corey has been connected with various watch and industrial instrument manufacturers during the past 18 years, and is also president of Danco Instruments, Inc. The new company is owned jointly by Danco and Moore Products Company of Philadelphia. Manufacturing has begun on a recorder chart drive that uses the regular instrument air supply as a power source. The new drive will be used for all pneumatic equipment.

C. D. Corey

A. J. Bent has been appointed director, industrial products division, by Westinghouse Air Brake Company, Wilmerding, Pennsylvania. Bent, formerly field sales manager of the division, will direct manufacturing, sales and marketing activities of the company's air compressors and pneumatic controls in the automotive, marine, oil rig, aircraft and industrial fields. **H. W. McCracken,** formerly district representative in New York, succeeds Bent as field sales manager, with headquarters at Wilmerding and **E. W. Kidd,** formerly representative in the Boston office assumes charge, with the same title, of the Eastern district in New York.

Houston's Welcome to the World Welcomes YOU . . .

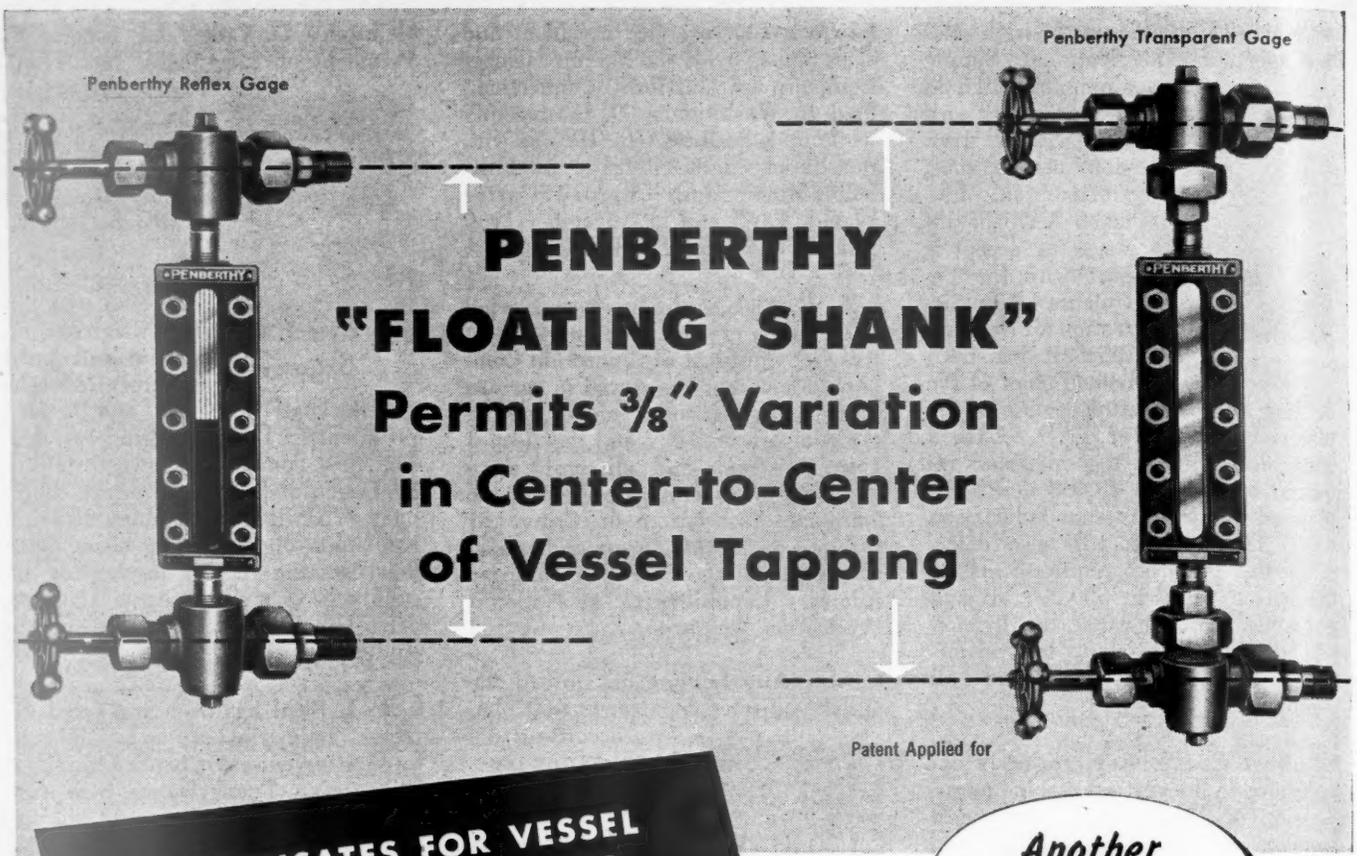
All rooms newly modernized and air conditioned . . . Four fine restaurants . . . 1,000-car garage . . . Central downtown location . . . Reasonable rates, from $4 single and from $6 double.

Home of beautiful EMPIRE ROOM, famous dine-dance rendezvous.

The CENTRALLY Located

RICE HOTEL

B. F. ORR, Management



PENBERTHY "FLOATING SHANK" Permits 3/8" Variation in Center-to-Center of Vessel Tapping

Patent Applied for

COMPENSATES FOR VESSEL TAPPING INACCURACIES

•

SAVES INSTALLATION TIME

•

REDUCES GAGE STRESSES

Another **PENBERTHY** *First*

An important new feature now available on all Penberthy drop forged steel gage valves is the "floating shank" . . . an improvement that has money-saving advantages to many users of liquid level and water gages.

The "floating shank" compensates for inaccuracies in the center-to-center distance of the tapped holes in the vessel on which the gage is mounted. The variation can be as much as 3/8". It provides a mounting flexibility not elsewhere obtainable . . . it saves time during installation of the gage . . . it eliminates stresses that are often induced during mounting.

The Penberthy "Floating Shank" can be had at slight additional cost . . . specify it on your next order for Penberthy drop forged steel (or alloy) gage valves.

4449

PENBERTHY PRODUCTS

PENBERTHY INJECTOR COMPANY

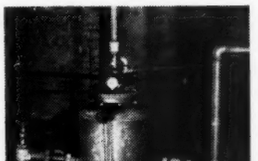
DIVISION OF THE BUFFALO-ECLIPSE CORPORATION

Detroit 2, Michigan

Established 1886 *Canadian Plant, Windsor, Ontario*

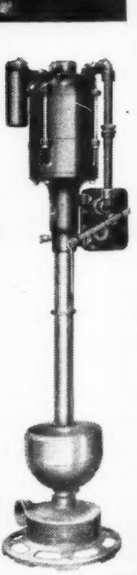
OTHER PENBERTHY PRODUCTS

PENBERTHY CYCLING JET PUMPS



Automatically operated by air, gas or steam pressure . . . Will pump without clogging any liquid that will flow through pipes. Ask for Bulletin 5030.

PENBERTHY EXPLOSION-PROOF SUMP PUMPS



Motor and switch totally enclosed. Underwriter approved for Class 1, Group D, and Class 2, Groups E, F and G hazardous location. Made of copper and bronze throughout. Ask for Bulletin 4929.

PENBERTHY EJECTORS

A simple jet pump operated by air, water or steam. Needs no lubrication . . . will not get out of order. Ask for Bulletin 5080.

▸ **Theodore R. Colville** has been assigned the management of all advertising and sales promotional activities for the Byron Jackson Company, according to a disclosure from that company. Colville will be in charge of the advertising for all four divisions. Colville has been with Byron Jackson for almost two years. He has been advertising manager for the pump division up to the present time.

T. R. Colville

▸ **E. E. Hardesty,** has become associated with Narmco, Inc., of San Diego and Costa Mesa, California, manufacturers of Conolon, Multiwave, Metlbond, and other Fiberglas laminates and metal-to-metal adhesives widely used in aviation and other industries. As manager of Narmco's San Diego factory, Hardesty brings to his new post a wealth of experience and training. For the past four years he has been plant manager and co-owner of Dumont Corporation in San Francisco, manufacturers of Fiberglas products for aviation, oil, sporting goods, and other industries.

▸ **Roy S. McKeever** has joined the sales force of the Knight Manufacturing and Supply Company of Tulsa, Oklahoma. McKeever, for many years associated with the Twentieth Century Manufacturing and Supply Company, will serve the oil and manufacturing industry out of the Tulsa office on fabrication, machining and shop work service, according to Dean Knight, company president. The Knight company also specializes in gas booster units, pumping units, and other oil field equipment and supplies.

Roy S. McKeever

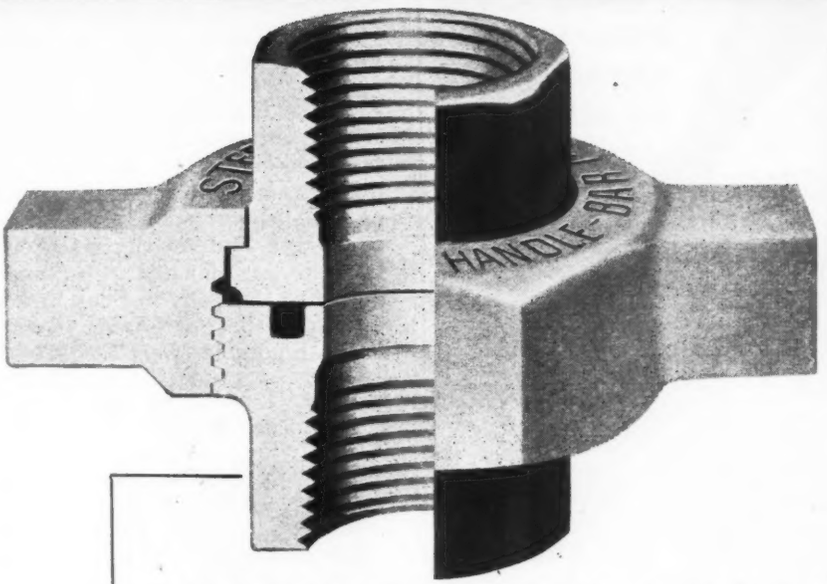
▸ **James E. Keffer,** former store manager at McCamey, Texas, for Continental Supply Company, has been transferred to San Angelo, Texas, in the same capacity. **Alvin L. Rice** former floorman at Odessa, Texas, has been transferred to McCamey as store manager. **C. K. Trease,** field salesman at Oklahoma City has been appointed store manager there. **William B. Holloway,** bookkeeper at Perry, Oklahoma, has been transferred to Pratt, Kansas, as store manager.

The Pipefitter's Best Friend

HANDLE-BAR

REG. U.S. PAT. OFF.

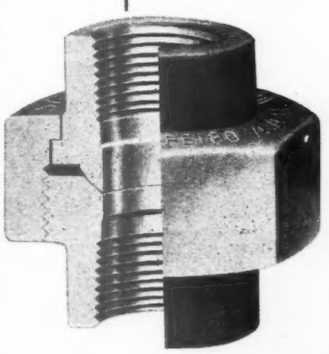
Forged Steel Unions



HANDLE-BAR "O" RING

REG. U. S. PAT. OFF.

HANDLE-BAR "O" RING Unions do not depend on compression or force as the terms relate to common gasket type unions. A positive pressure seal is effected with a synthetic oil-resistant "O" Ring set in a groove between the two mating surfaces. The one and only sealing method that does not require brute force to make a tight joint on pressures to 3000 lbs. C. W. P. and temperatures to 212 F. Special Silicone "O" Rings available for temperatures to 500 F. "O" Rings will not drop out when unions are disconnected, but they are replaceable at a low cost.



PETRO A. A. R.

REG. U. S. PAT. OFF.

One important feature of this dependable Union is its Seat Design. A differential in hardness of 40 points Brinell is maintained between the steel to steel seats (ball to 45 cone) by cold rolling the female seat prohibiting possible seizure or gualing at high temperatures. Hot forged from A. I. S. I. 1023 killed steel. Nut threads permanently lubricated with Udylite Cadmium. Pressures to 3000 lbs. Temperatures to 1000.

Write Dept. P for illustrated catalog or refer to listings in Composite Catalog pages 3140-3141, Refinery Catalog page 538, and Chemical Engineering Catalog pages 980-981.

ORDER BY TRADE NAME FROM YOUR LOCAL JOBBER

ORIGINATORS AND PIONEERS OF STEEL UNIONS SINCE 1912

CLAYTON MARK & COMPANY

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Extra-Duty Line—50% heavier than standard.

Chrome-Clad non-glare, durable finish on entire line.

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▸ **C. A. de Vyver** has been appointed manager for insulations of Johns-Manville, it was announced by F. J. Wakem, merchandise manager of the industrial products division and vice president of Johns-Manville sales corporation. Wakem also announced the appointment of **Duane D. Crews** as manager of construction of the J-M industrial products division.

De Vyver joined Johns-Manville in 1929 as a research assistant at the company's laboratories at Manville, New Jersey. Crews joined Johns-Manville in 1935 as construction manager for one of the company's subsidiaries.

▸ **R. V. Burnette** has been named service manager for Rockwell Manufacturing Company's meter and valve division. His duties will also consist of establishing repair procedures in factories and district warehouses. Burnette was affiliated with Standard Steel Car Company in Sharon, Pennsylvania, before joining the Pittsburgh Equitable Meter in 1926.

▸ **H. D. Leisenring** has been appointed sales manager, Pacific Coast division, A. O. Smith Corporation. Leisenring, formerly sales manager of the Pittsburgh Meter Company, has over 20 years experience in engineering and sales of service station pumps and petroleum meters. His office will be in Los Angeles.

H. D. Leisenring

▸ **Elmer J. Nooter,** president Nooter Corporation, St. Louis, Missouri, died April 14. Though only 42 at his death, Nooter had devoted 25 years to the industry. Succeeding Nooter will be **Robert J. Ryan,** former executive vice president. Ryan has been with the company since 1923.

R. J. Ryan

▸ **James S. Anderson,** assistant general sales manager of The Babcock and Wilcox Tube Compay, has just assumed the duties of chief of the newly created tubing section of the iron and steel division of the industries operations bureau of the National Production Authority. His headquarters will be in the offices of the NPA in the new general accounting office building, Fifth and G Streets, N.W., Washington, D. C. Anderson was graduated from Case Institute of Technology with a degree in mechanical engineering.

▸ **A. F. Reinking,** formerly assistant sales manager, has been named manager of the steam turbine sales division of Worthington Pump and Machinery Corporation. He will make his headquarters at Worthington's Wellsville plant. Reinking was graduated from Rose Polytechnical Institute with the degree of mechanical engineer, then completed the Worthington Student Training Course in 1927, and was assigned to the New York district office.

Champion Basketball Team. Winners of the Compton Night League, this team is sponsored by Oil Base, Inc., Compton California. They are, back row: Doyne Wilson, research director, Oil Base, Inc.; Jack Coulter, Don Sorensen, Pete Chiello, George Miller, president of Oil Base. Front row: Bud Cloven, Cal Michelson, Gordon Paulson.

Hill, Hubbell and Company men attending a recent 3-day annual sales meeting in Cleveland, Ohio, are: Front row, Earl Brightbill, assistant superintendent, Lorain plant; R. A. McCarthy, Dallas salesman; M. M. Bowen, Hill, Hubbell manager; Bryan Patterson, Salt Lake City salesman; and J. C. Maxwell, superintendent, Girard plant. Back row, C. D. Cobbett, Pittsburgh salesman; Norman Atchison, Cleveland office; R. J. Young, New York salesman; C. L. McGarvey, general superintendent; Lee Maffei, assistant superintendent, Girard plant; George Hudock, Chicago salesman; Glenn Killian, Cleveland, and Lee Hamilton, superintendent, Lorain plant.

▸ **Robert L. Craig,** supervisor of employment since 1949 for The Youngstown Sheet and Tube Company has been appointed assistant to Herman J. Spoerer, director of industrial relations. **George B. Curl,** assistant to A. H. Lemon, supervisor of industrial relations in the Youngstown district, succeeds Craig as supervisor of employment. Craig went to Ohio State University College of Commerce and Business Administration and received a bachelor of science degree in journalism in 1939. He joined Youngstown Sheet and Tube in 1939. Curl joined The Youngstown Sheet and Tube Company as a mail boy at the age of 18. Since 1942 he has been in industrial relations work.

▸ **W. B. Ashby** has been elected secretary of the American Meter Company. Ashby attended Georgia Institute of Technology, and after graduation joined the American Meter Company sales engineering staff in 1940. In 1947 he operated the company's Orlando, Florida meter repair shop, and in 1948 he conducted a survey of LPG operations in South America for the company. He became the vice president, sales, in 1948.

W. B. Ashby

▸ **Gerald D. Dodd,** assistant to the president of Foster Wheeler Corporation will assume charge of manufacturing at the company's Carteret, New Jersey, and Dansville, New York, plants, succeeding **William Lonsdale,** vice president in charge of manufacturing, who has retired from active duty. Lonsdale who has passed the mandatory retirement age of 70 years will be retained as a special consultant prior to his full retirement, Admiral E. W. Mills, Foster Wheeler president, said in making the announcement. Dodd became affiliated with Foster Wheeler Corporation in 1929 at which time he was in charge of the Heater and Evaporator Group. In August, 1950, he became assistant to the president. Lonsdale joined the company in 1907.

▸ **Leo J. Haller** has been appointed as sales engineer in the Pittsburgh branch office of Builders Iron Foundry and its associates, Builders-Providence, Inc., Omega Machine Company, %Proportioneers, Inc.%. Haller, a graduate of the University of Pittsburgh, has previously been a sales engineer with the Superior Valve and Fitting Company and a practice engineer with the Jones and Laughlin Steel Company, both in Pittsburgh.

▸ **John D. Bailie** has been promoted from research engineer in the company's Detroit laboratories to chief automotive engineer in the central sales region, with headquarters in Chicago, for Ethyl Corporation. After graduation from Pennsylvania State College in 1939, Bailie joined Ethyl Corporation as an assistant research engineer in the Detroit laboratories. For the past four years he has been a research engineer with the Technical Service division, first with the commercial engine and fleet section and more recently with the agricultural section for Ethyl.

Cameron Iron Works' employees with 5 years' service or more attended a banquet in their honor recently in one of the new shop buildings in Houston, Texas. This is an annual event at which time employees are presented gold service pins and the company's progress for the last year is reviewed and plans for the second are outlined.

A BARREL OF BLUE

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ROLLING tanks or taking price penalties on high BS&W oil are costly nuisances you can eliminate when you put Visco to work on your leases. You get the uniform, high-quality Visco formulas best suited to produce dry oil at lowest cost—PLUS the recommendations and assistance of your Visco Field Service man, available 24 hours a day, every day, to help you.

If you have an emulsion-breaking problem now, call Houston, CAPITOL 7300, collect, for fast action...Might be wise to call even if you are not in trouble...No one ever got fired for saving his company money on treating costs.

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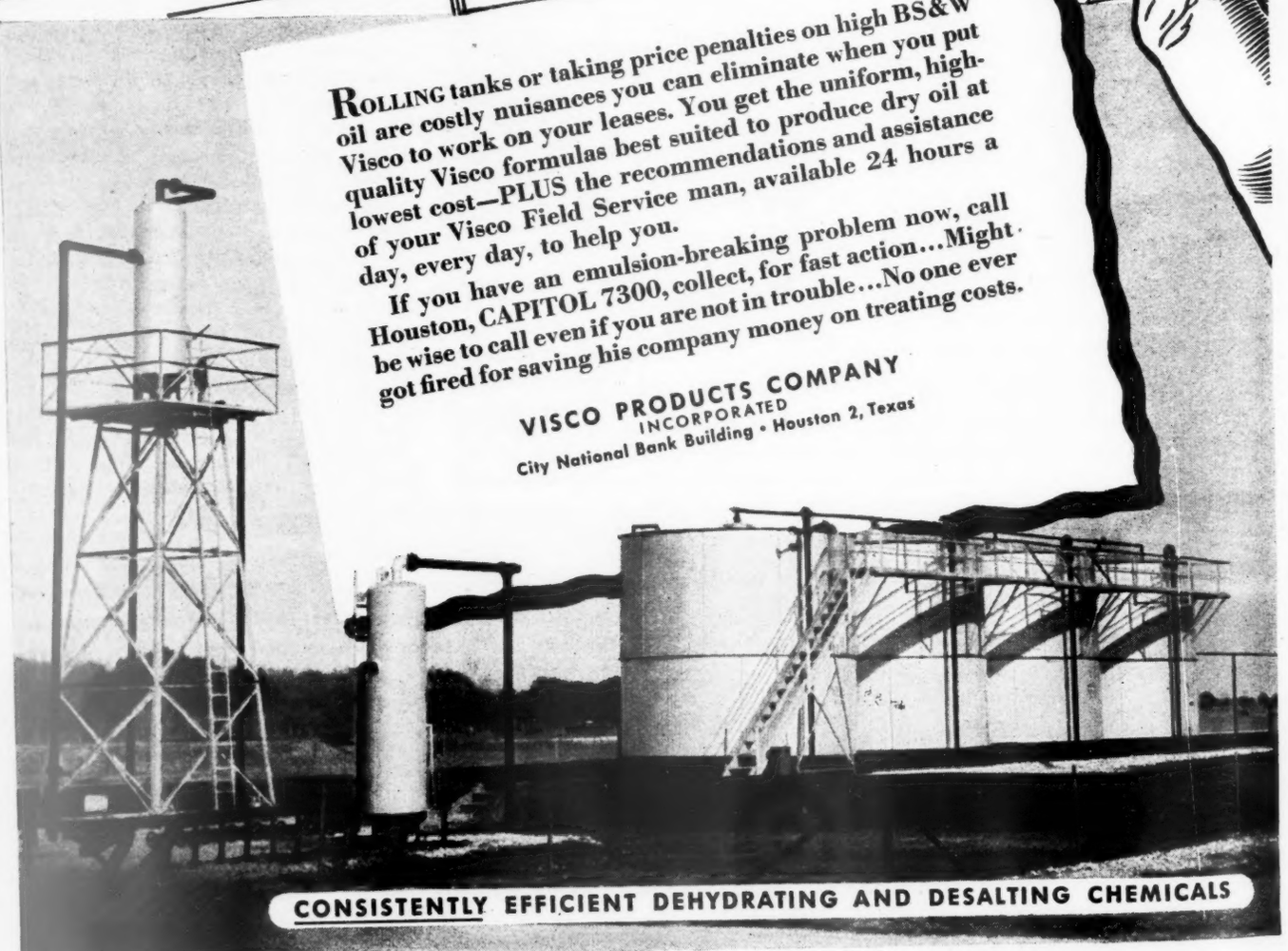

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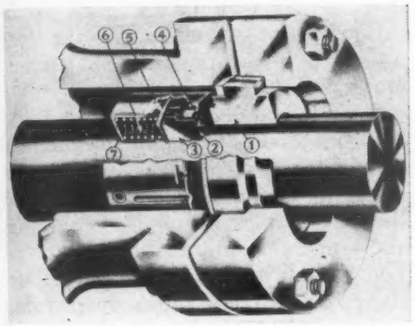
New Machinery and Supplies

Use reply card to procure promptly complete information and prices of products described here in brief.

Circle corresponding letter or letters on reply card.

(A) MECHANICAL SEAL

A new, improved mechanical seal has been announced by Crane Packing Company. The new seal, designated as the Type 9 mechanical shaft seal, per-



forms effectively under severe temperature and corrosive conditions. The Type 9 seal incorporates a flexible ring molded from the new plastic, Teflon. The Teflon "wedge-ring" enables this seal to combine the chemically-inert properties of Teflon with the flexibility and positive sealing components essential to effective mechanical sealing. The Type 9 seal, which can be employed at temperatures up to 500 F, has been designed for service on various rotating shaft applications, such as centrifugal pumps, turbines, positive displacement pumps, and agitators. — Crane Packing Company.

Circle letter (A) on reply card.

(B) GAS ENGINES

A new high compression spark ignition gas engine manufactured by Worthington Pump and Machinery Corporation has been installed in Ajo Heights, Arizona. The new engine is a gas engine with diesel compression. It is a four-cycle engine suitable for 50 per cent increase in power by supercharging at a future date. The company claims that this new high compression type engine uses 27 per cent less fuel than the conventional type of spark ignition gas engine. Worthington Pump and Machinery Corporation.

Circle letter (B) on reply card.

(C) DIESEL ENGINES

Lister-Blackstone's new line of diesel engines, the series EV and EVS, recently introduced to the power market, have demonstrated their suitability to continuous duty stationary generating service, the manufacturer has reported. The EV series, built to Lloyd's specifications throughout, includes 2-, 3-, 4-, 5-, 6-, and 8-cylinder models developing 90, 135, 180, 225, 270, and 360 hp at 600 rpm. The turbo-charged EVS series is offered in 4-, 6-, and 8-cylinder sizes rated 240, 360, and 480 hp at the same speed. All models have bore and stroke dimensions of 8¾-in. by 11½-in. Lister-Blackstone.

Circle letter (C) on reply card.

(D) PRE-MEASURED ROPE

New Bedford Cordage Company is now offering its Sisal rope in factory pre-measured rope, marked in red at 10 ft intervals. Its Manila rope has been factory pre-measured for some time. Sisal rope leaves the factory packed in compact, protective cartons. Size, weight, and brand are clearly printed. The cartons are in red and black for Manila, and green and black for Sisal. Accurate markings enable the customer to determine the exact amount of rope on hand, and assures him of getting the exact amount required. New Bedford Cordage Company.

Circle letter (D) on reply card.

(E) IGNITION SET

A new ignition set of 11 pieces, covering all the tool requirements for servicing normal ignition jobs, is now being marketed. The set includes the 6 most popular sizes of open end ignition and electric wrenches, ignition pliers, feeler gauge, neon screw driver, point file, and adjustable wrench. The tools come packed in a leatherette roll. Bonney Forge and Tool Works.

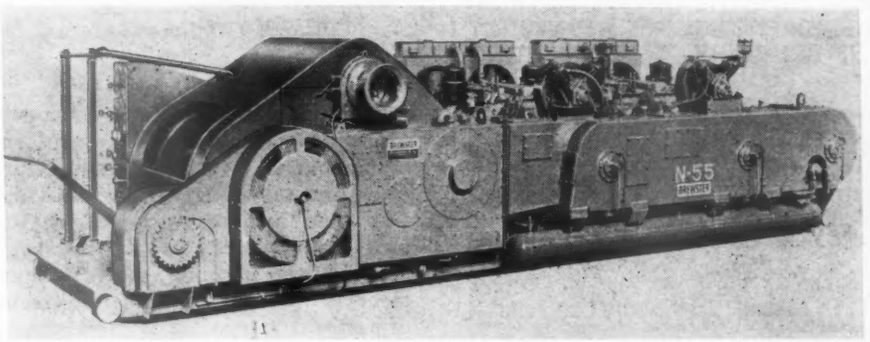
Circle letter (E) on reply card.

(F) DRILLING RIG

Brewster's newest rig, the N-55, is designed for 6500 ft drilling and incorporates the features ordinarily found only in larger rigs. Designed for 400 hp input, it has 8 drum speeds forward with 4 reverse and 4 rotary speeds forward with 2 reverse. The brakes are cooled by circulating water; compounds are available for 2 or 3 engine hook-ups, and the design of the transmission makes possible rapid changes of speed while the parts are in motion. The over-all width of the rig has been kept to 8 ft to meet state highway requirements without special permits. The pump drive sheave is mounted between 2 bearings to eliminate fatigue failure of the shaft. The rig is designed for a 350 hp pump. The entire rig is controlled from a central control panel. —The Brewster Co.

Circle letter (F) on reply card.

Brewster rig designed for 6500 ft drilling.



(G) COATINGS, WRAPPERS

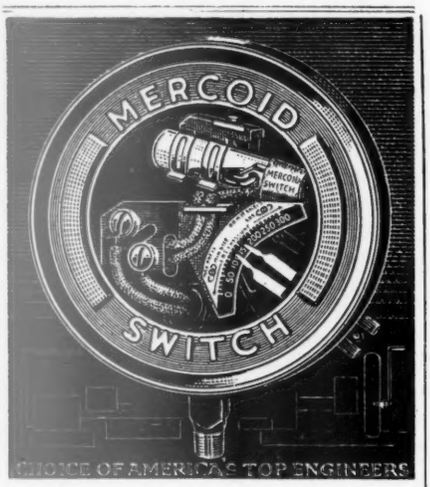
Under the trade name Mummy-Wrap, a new line of protective coatings and wrappers for pipe lines is announced by The Trenton Corporation. Features, the company states, include freedom from holidays; extreme resistance to water, water vapor, chemical and bacterial action; high resistance to mechanical damage; and high dielectric strength. These coatings include dopes for application by hand and by machine for use next to pipe, over wrappings, and for patching and reconditioning. These coatings include the Trenton innercoat, overcoat, primecoat, duo and tri-ply Mummy Wrap. The Trenton Corporation.

Circle letter (G) on reply card

(H) CEMENTING UNIT

International Cementers' newest type cementing unit designed for ICI domestic service and export sale is designated as 108-T. It has an International Harvester Model LF-192 chasis, which has a 193 in. wheel base, 3 axle with rear 2 driving, air brakes, and 10:00 by 20 tires. The pump is an oilwell 48P special, triplex plunger type with 4½ by 8 in. hardened and ground steel plungers. The tank has a 200 cu ft capacity, divided and calibrated. International Cementers.

Circle letter (H) on reply card.



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MERCOID CONTROLS ARE EQUIPPED WITH MERCURY SWITCHES, THEREBY INSURING GREATER SAFETY, BETTER PERFORMANCE AND LONGER CONTROL LIFE

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4201 BELMONT AVE. CHICAGO 41, ILL.

(I) TRACTOR SHOVEL

A new development in track-type tractor shovels called the Model T12, has been announced. The basic and

significant feature of this machine is the fact that it is a complete, integrated design of track-type tractor and shovel, rather than a front end attachment for a conventional crawler tractor. Its basic advantages over such conventional arrangements are many, but the chief ones are that the engine is mounted at the rear to provide maximum balance and stability, the operator is situated high and forward where he has fullest visibility and there is a special full-reversing transmission that provides 4 forward speeds and 4 corresponding but faster reverse speeds. Frank G. Hough Company.

Circle letter (I) on reply card.

(J) TWO-WAY RADIOS

The first all-electronic selective dispatching method for two-way radio systems has been developed by General Electric. The method permits "private" conversations between a dispatcher and an individual mobile unit, or a specific group of mobile units within a two-way radio system. The new equipment allows separation of a system into as many as 10 groups. All individuals in a group hear a dispatcher's call, but when the called party responds, all other receivers in the group remain silent. A mobile operator, under the new method, would hear fewer calls not intended for his attention, reducing the number of call-backs and repeats, and lessening driver fatigue, G-E engineers state. General Electric, Commercial Equipment Division.

Circle letter (J) on reply card.

(K) GASOLINE HAMMERS

Introduction of improved models of Barco portable gasoline hammers, is announced by Barco Manufacturing Company. Used in the construction field and many industries for pavement breaking, rock drilling, spading, and tamping, the new hammers feature simplified arrangement of parts made possible by use of a new ignition coil-vibrator-condenser assembly, which is now situated in the right hammer handle. The new assembly weighs only a few ounces. It replaces a coil several times heavier and larger, which formerly was a separate part connected to the hammer by heavy cable. By putting the coil in the handle, the length of the high tension lead is reduced from 10 ft to about 5 in. thereby making for better ignition. Barco Manufacturing Company.

Circle letter (K) on reply card.

(L) HYDROGENATOR

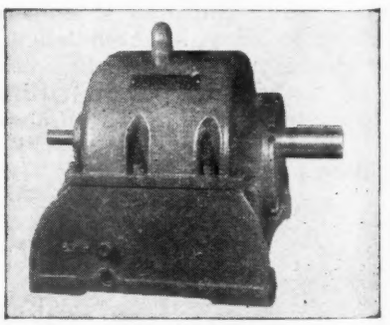
A new hydrogenator, designed for quick, thorough dispersion of gases and solids, has been introduced by Struthers Wells Corporation. Featuring the radial propeller agitator, this hydrogentor is built for each application to operate under specific conditions of pressure, vacuum, temperature, and degree of agitation.

Included in the design are a right angle motoreducer, double mechanical seals with all parts accessible without removing drive, manhole with hinged cover, semi-flexible drive coupling, and removable bottom guide bearings. The radial propeller agitator is designed to provide rapid overturning and turbulent motion in the liquor, thereby dispersing and entraining both the hydrogen and catalyst. — Struthers Wells Corporation.

Circle letter (L) on reply card.

(M) SPEED REDUCERS

New type DB double-reduction speed reducers, in ratings from 1 to 100 hp, are available from Westing-



house Electric Corporation. They are designed for applications on small- to medium-size drives where the prime mover is coupled or belted to the gear unit. These double-reduction speed reducers use all-external type helical gearing, arranged in a horizontal plane. When coupled to an electric motor, a straight-line drive results. Eight unit sizes are available; 12 standard gear ratios range from 6:25 to 58.3:1. Westinghouse Electric Corporation.

Circle letter (M) on reply card.

Noise Control and Surge Control IN REFINERIES

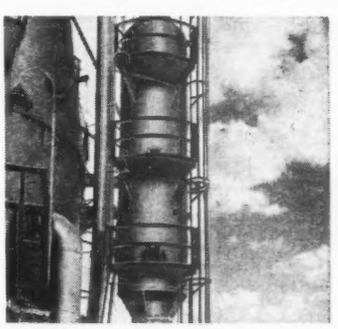
New catalytic cracking unit in an Ohio Refinery. Plant equipped with Burgess-Manning Gas and Air Line Snubbers, Exhaust Snubbers, and Flue-Gas Discharge Snubbers.

● On engines and compressors used in many stages of refinery process . . . from the crude oil storage tanks . . . desalter . . . distillation column . . . catalytic cracker . . . you will find Burgess-Manning exhaust Snubbers, intake Snubbers, gas and air line Snubbers, flue-gas discharge Snubbers . . . these Snubbers reduce engine exhaust and compressor intake noises to the desired level, and reduce pipe line surging.

● **Specialists in Surge Control in Gas and Air Piping**

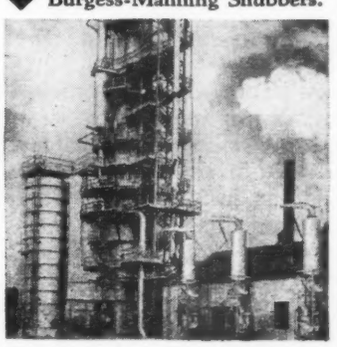
To keep pace with new needs in the petro-chemical industries, Burgess-Manning has broadened its research during the past few years to develop a special Snubber capable of reducing surging in compressor gas and air piping systems . . . practically eliminating resultant vibration . . . simplifying metering. Call in Burgess-Manning engineers, today.

Oklahoma refinery equipped with Burgess-Manning Exhaust and Gas and Air Line Snubbers.



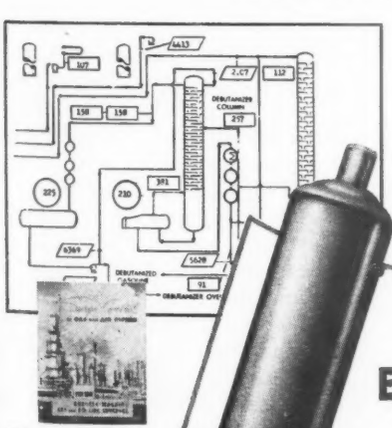
▲ Texas Refinery. Burgess-Manning Snubber installed on flue-gas blow off.

Michigan Refinery equipped with ▼ Burgess-Manning Snubbers.



BURGESS-MANNING COMPANY

749 East Park Avenue, Libertyville, Illinois



Write for new booklet, "Surge Control."

Burgess-Manning Gas and Air Line Snubber.

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From well head through the refinery gate ...it's Burgess-Manning

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Engineering & Sales Office

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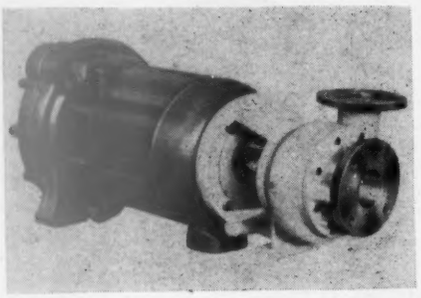
1203 Dragon Street
Dallas, Texas

(N) TURBINE DRIVEN PUMP

The installation and operating advantages of the TL Bilton pump design are now available to steam power users with this new steam turbine



driven model. This newest addition to the Byron Jackson pump line is a combination of standard TL Bilton pump sizes with one of two Moon steam turbines. The two steam turbine sizes used both have the same shaft extension and rabbitt fit so that one standard TL Bilton connector and shaft sleeve is used with all pump and turbine combinations. The close-coupled unit is easy to install since space requirements are small and no rigid foundation is necessary. It can be mounted at any angle (including wall mounting). Standard models are recommended for water supply, air conditioning, general liquid handling, etc.—Byron Jackson.

Circle letter (N) on reply card.

(O) GRAPHITE GROUND ANODE

A new size 3 by 60 in. "National" graphite ground anode is announced by National Carbon Company, a division of Union Carbide and Carbon Corporation. "National" graphite ground anodes are recommended for the cathodic protection of pipe lines, tank farms, refinery equipment, ships, electric sub-stations and all sorts of underground and underwater metal structures. They are supplied complete with 36 in. long insulated No. 8 weatherproof cable. Special cables are available for use in refineries or in other oil soaked areas. National Carbon Company, Union Carbide and Carbon Corporation.

Circle letter (O) on reply card.

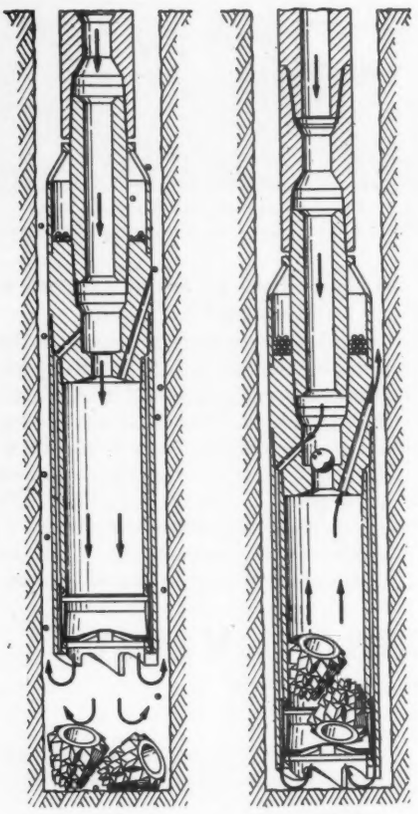
(P) SCRATCHERS

A new scratcher construction has been developed, which provides protection for the mud cake and increased area for return circulation while the casing is run into the hole. A highly effective scratching action for thorough removal of mud cake from the formation in the cementing zone after casing reaches bottom is also claimed for B and W multi-flex scratchers. The "upswept" flexible construction of the multiple wire scratching fingers permits them to point upward as the casing is run so that they do not dig into the mud cake or form an obstruction to impede return circulation. When the casing has been run to the landing point and is worked up and down the spring units reverse and dig sharply into the mud cake, breaking it into small fragments that are easily circulated out of the hole.—B and W, Inc.

Circle letter (P) on reply card.

(Q) JUNK CATCHER

A new addition to the Baash-Ross line of field-proved fishing tools is a cone and junk catcher that recovers bit cones, rollers, bearings, pieces of metal, and other junk—both small and large—lost in the bottom of the



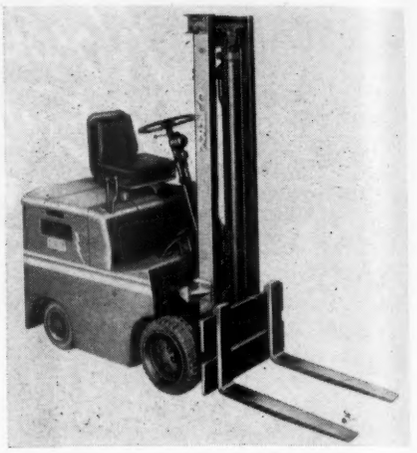
"A" "B".

hole. Basically the Baash-Ross Costin cone and junk catcher consists of a tool with two separate "containers"—one for holding the rollers, bearings, and other small pieces of junk and the other for holding the bit cones and larger parts to be recovered. The tool is first run into the hole close to bottom, and as circulation is established in the normal way, all small pieces of junk are picked up and circulated with the mud stream up past the outside of the tool. Baash-Ross.

Circle letter (Q) on reply card.

(R) FORK-TRUCK

Features of the Clipper, electric battery-powered fork-lift truck, as announced by Clark Equipment Company, include increased speed, 2000-lb



capacity at 24-in. load-center, "fingertip" directional lever, automatic acceleration, "deadman" safety control, pivot-mounted steering axle, and cushion-style tires as standard equipment. The "fingertip" directional control lever is mounted on the steering column for selection of direction of travel and simultaneous engagement of first point-of-power. Shifts from one point of power to another are timed automatically in accordance with torque requirements. When the driver's seat is vacated, the control lever is locked in neutral, and a parking brake on the motor drive shaft is set automatically. The truck can be moved only when the driver's seat is occupied, or depressed.—Clark Equipment Company.

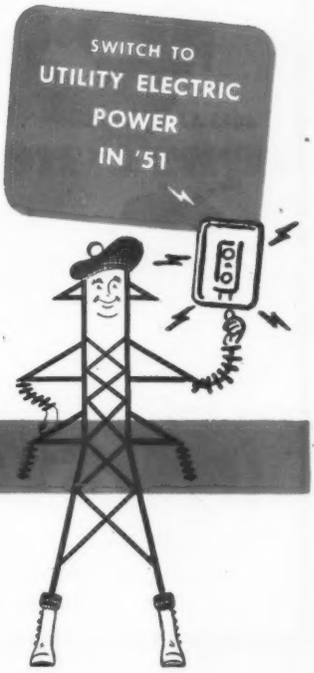
Circle letter (R) on reply card.

(S) BEAM PUMPING UNIT

The Pelton Water Wheel Company has recently announced a new beam pumping unit in various sizes to augment its line of long stroke hydraulic pumping jacks. Pelton recently acquired the line of Pacific Western beam pumping units. After extensive field surveys, a complete redesign program to modernize the product was undertaken. A feature of the new Pelton beam pumper is the weight counterbalance adjustment by which one man may easily and safely change the counterbalance. Pelton's Canadian associate, the Vancouver Engineering Works, is manufacturing and distributing the beam pumping units in Canada through a subsidiary company, the Lucey Export Company of Canada. Pelton Water Wheel Company.

Circle letter (S) on reply card.

Recognize this scene? The view is a portion of the 282 producing wells in the Goose Creek Field near Goose Creek, Texas, which are pumped by Electric Power. With less manpower and with definitely less maintenance cost a few wells or hundreds of wells can be pumped AT LOWER COST. If saving power dollars during these inflationary days appeals to you, don't decide until you have fully investigated the advantage of LOW COST Purchased Electric Power!



Petroleum Electric Power Association

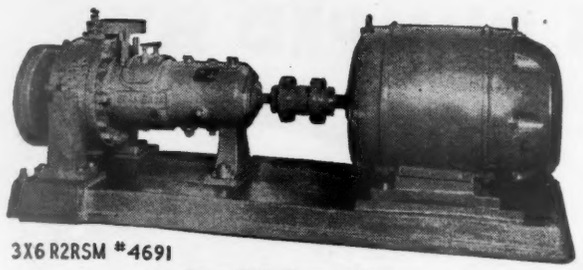
ORGANIZED IN THE INTEREST OF GREATER SERVICE TO THE PETROLEUM INDUSTRY

CALL YOUR NEAREST ELECTRIC SERVICE COMPANY FOR MORE FACTS

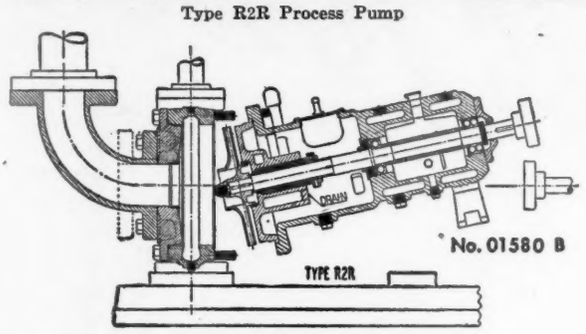
OR ADDRESS YOUR REQUEST TO P. O. BOX 2771, DALLAS, TEXAS

DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



Type R2R Process Pump



Type R2R Process Pump

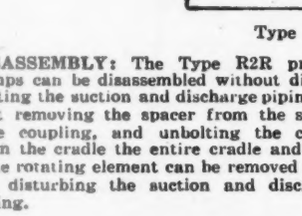
DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

OPERATING RANGE: Type R2R, Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.

Capacities: 50 to 2000 Gallons per minute. Heads: Up to 400'. Speeds: 900 RPM to 4000 RPM.

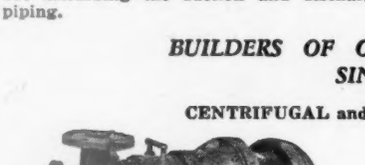
BUILDERS OF OUTSTANDING PUMPS SINCE 1869

CENTRIFUGAL and RECIPROCATING PUMPS

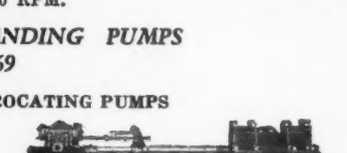


Close Coupled Centrifugal Pump

Horizontal, Single Style, Double Acting, Piston Type, Close Clearance Pump. Designed to handle volatile liquids



Pedestal Mounted Centrifugal Pump



Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump

Double Pedestal Bearing Centrifugal Pump

Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

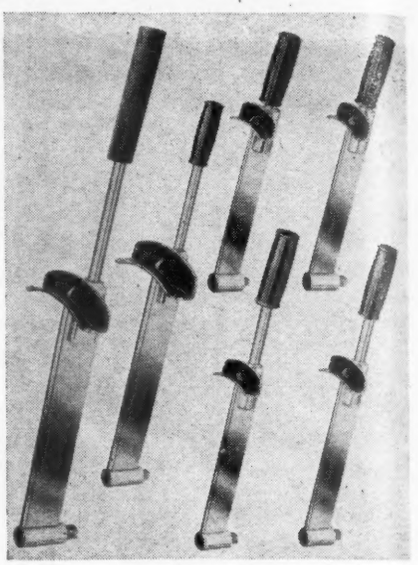
323 W TENTH ST.

Branch Offices: NEW YORK, N. Y., HOUSTON, TEXAS

Representatives in Principal Cities

(T) TORQUE WRENCHES

A new series of torque wrenches for 3/8, 1/2, and 3/4-in. square drives has been announced by Bonney Forge



and Tool Works. The new torque wrenches feature a broad, pre-tested tension bar and, because of their long, thin design, they provide easy access to tight spots. Handles are pivot-mounted to maintain a constant leverage radius. Easily read calibration scale available in foot-pound or inch-pound calibrations as desired. Bonney Forge and Tool Works.

Circle letter (T) on reply card.

(U) ROTARY HOSE

Development of a new reinforced rubber and fabric rotary hose for high pressure oil well drilling operations was recently announced by the New York Belting and Packing Company. Four plies of wire reinforced together with heavy duty rubber and fabric construction gives the hose the strength to withstand the pressure of the heaviest pumps in the oil fields today. The new hose eliminates the need for transferring from rubber to steel hose in high pressure work.—Continental Supply Company, distributors.

Circle letter (U) on reply card.

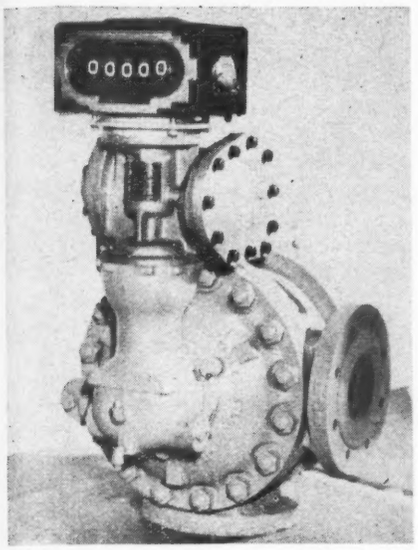
(V) BUSHING DRIVER SET

A new, heavy duty bushing driver set covering the requirements of most trucks, buses and tractors, as well as farm, road, construction and industrial equipment, is now being shown by Bonney Tool distributors. Set includes nine pieces in metal box, and covers a broad range from $1\frac{5}{16}$ in. to $1\frac{7}{8}$ in. The drivers are made of alloy steel and carefully heat treated. —Bonney Forge and Tool Works.

Circle letter (V) on reply card.

(W) REGISTRATION UNIT

A new remote registration system, for metering petroleum products at one point while recording the volume metered and printing receipt records



in a station at some distance from the meter has been developed. The Rockwell remote registration unit consists, essentially, of a transmitter on the meter and a receiver in the office, or at the station in which metering readings are to be made or recorded. Both transmitter and receiver are equipped with electrical synchronous type motors, mounted in explosion proof Underwriters' approved housings. Each is equipped with a register. Rockwell Manufacturing Company.

Circle letter (W) on reply card.

(X) HEAT TRANSFER UNITS

A new standard line of electrically heated Dowtherm heat transfer units has been developed by Struthers Wells Corporation. Supplied complete with instruments, piping, insulation, and other accessories, these units are ready for immediate use upon delivery. With capacities ranging from 100,000 to 500,000 Btu's per hour, these heaters have a temperature range to about 750 F using Dowtherm as a liquid or vapor medium. In addition, other heat transfer fluids may be utilized in this equipment. The entire unit may be base-mounted at the factory or supplied with all essential equipment for mounting.—Struthers Wells Corporation.

Circle letter (X) on reply card.

(Y) CHAIN DRIVES

A new power transmission chain drive, has been announced by the Morse Chain Company. Opening whole new fields of possible applications in industry, company officials say, Morse Hy-Vo (high velocity) chain drive makes possible single drive units capable of transmitting as much as 5000 hp, at linear speeds up to 6500 ft per minute, or rotative speeds up to 3600 revolutions per minute. A Hy-Vo drive only 2 in. wide has transmitted as much as 500 hp. Morse officials state, however, that the current critical shortages of necessary materials have made it necessary to restrict orders for the new drive only to those with defense or essential ratings. Morse Chain Company.

Circle letter (Y) on reply card.

(Z) NEW PACKAGING

Effective immediately, Strata-Crete and Strata-Seal, will be packaged in bags with a modern, two color design, according to an announcement by Robert L. Cornish, advertising manager of the Great Lakes Carbon Corporation's building products division. Both products are used in the oil field industry—Strata-Crete for lighter cement slurries and Strata-Seal to combat lost circulation. The basic bag design was created by Charles C. S. Dean, one of the prominent designers in America. Strata-Crete will be packaged in a 4 cu ft kraft bag of maroon and red shades. Strata-Seal will be packaged a 4 cu ft kraft bag of grey and red shades. Great Lakes Carbon Corporation.

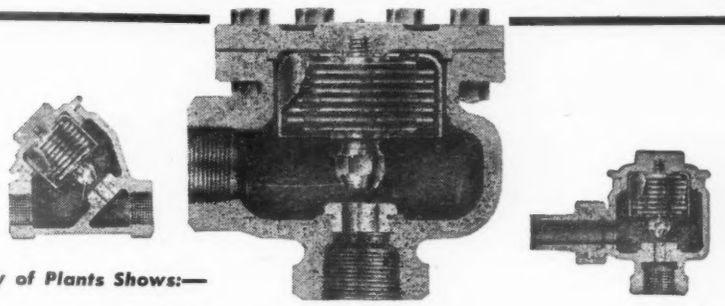
Circle letter (Z) on reply card.

(AA) WORM, GEAR VALVES

Worm and gear operated valves have been added to the line of Homestead-Reiser lubricated plug valves. The new valves have the patented "Self-Seald" construction characteristic of all Homestead-Reiser valves;

port area equivalent to 100 per cent of the area of standard pipe; are cast in semi-steel, and made in 8, 10, and 12 in. sizes.—Homestead Valve Manufacturing.

Circle letters (AA) on reply card.

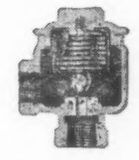


Survey of Plants Shows:—

15 of 20 Engineers Prefer Nicholson Traps

To determine the best steam trap on which to standardize, a large processing firm recently asked their plant engineers for their preference. In 15 out of 20 plants the choice was Nicholson.

The repeated adoption of Nicholson steam traps in plants currently in big "cost-reduction-through-modernization" programs is another indication of their advanced features. To learn why an increasing number of leading plants are standardizing on Nicholson thermostatic steam traps send for our catalog. 5 types for every power, heat, process use; size ¼" to 2"; press. to 225 lbs.



Bulletin 450 or see Sweet's

W. H. NICHOLSON & CO. 217 OREGON STREET WILKES - BARRE, PA.

Trade Literature

Publications will be sent free.

(AB) INDUSTRIAL PIPING

A new edition of the Crane Company's Piping Pointers manual has been announced. It is also offering its Piping Pointers film for use with the manual in training beginners and refreshing veterans in industrial piping crews. The new manual covers the fundamentals of sound piping practices in non-technical language. It discusses the various types of valve designs and how each should be used. It illustrates and names more than 80 kinds of fittings. Crane Company.

Circle letters (AB) on reply card.

(AC) STEAM TURBINE

The Whiton Machine Company recently issued a concise booklet describing and giving technical data for the vertical drive steam turbine. This type drive is built in 3 general sizes 14 in. rotor BTV, 24 in. rotor BKV, and 36 in. rotor BEV handling industrial applications up to 600 hp with thrust loads of 8000 lb or more and steam conditions as high as 900 psig and 900 F total temperature. The Whiton Machine Company.

Circle letters (AC) on reply card.

(AD) TUBING HEAD

Features and operation of National Supply's new Type "E" tubing head (2000 psi working pressure) for flowing and pumping wells are illustrated in Bulletin No. 374. The National Supply Company.

Circle letters (AD) on reply card.

(AE) NOZZLES, FLANGES

A new Taylor Forge catalog, No. 501, is now available. The catalog describes and illustrates Taylor Forge nozzles, welding necks, and large diameter flanges. Also included in the catalog are data covering standards of the Tubular Equipment Manufacturers Association (TEMA Standards). Its thumb index facilitates the reader's finding the section he is most interested in, and diagrams, tables, and charts make it more understandable. The last section, "Modern Flange Design," may be obtained as a separate bulletin by requesting Bulletin 502. Taylor Forge and Pipe Works.

Circle letters (AE) on reply card.

(AF) AIR, GREASE DRYER

A four-page brochure has been published on the Kemp Oriad dryer. These dryers are for use in drying air or greases in moderate quantities used to actuate tools, valves, instruments, etc. Models in a range of sizes are available. The Oriad dryer provides a source of dried gas in moderate quantities. It consists of dual absorbing towers, each charged with sufficient quantity of granular desiccant to continuously dry the volume of gas entering under the service conditions specified. All operations, including tower reversals, are controlled by program timer. C. M. Kemp Manufacturing Company.

Circle letters (AF) on reply card.

(AG) DIFFERENTIAL SYSTEM

A new bulletin describing Peabody Engineering's constant differential system for use on oil combustion installations has been published. The 2-color, 4-page bulletin includes a diagram CD pump system. The Peabody differential pump system extends the capacity range of the wide range burner and provides continuous and complete master control for any number of Peabody burners throughout all variations in capacity. The system can be designed to give efficient combustion and full control of flame characteristics over streaming ranges of 20 to 1 or more with all burners in service. Peabody Engineering.

Circle letters (AG) on reply card.

(AH) STAINLESS STEEL

A new booklet, *Armco Precipitation Hardening Stainless Steels*, has been published by Armco Steel Corporation, describing the properties, available forms, and fabrication of both Armco 17-4 PH and 17-7 PH stainless steels. The illustrated 16-page booklet describes the advantages, corrosion resistance, heat treatment, and mechanical properties of Armco 17-4 PH. Also included are data on high temperature properties, fabrication, and forms in which the steel is supplied. Photographs show typical applications for Armco 17-4 PH stainless steel, which can be heat treated at 850-900 F to a tensile strength of 190-210,000 psi and a hardness of 40-45 Rockwell "C." The Armco Steel Corporation.

Circle letters (AH) on reply card.

(AI) BACK HOE CRANE

A brochure illustrating and describing the new back hoe crane adapter developed by Schield Bantam Company is now available. The new adapter is reported to replace one-purpose equipment and extra work crews for trenching, hoisting, and backfilling operations. The truck mounted Bantam back hoe digs 100 ft of 5 ft trench per hour. It can be converted to crane hoist on the job in 5 minutes for lowering pipe, valves, etc., into the trench. It hooks on the Bantam backfill blade, to backfill own trench. Schield Bantam Company.

Circle letters (AI) on reply card.

(AJ) CLEANING

Discussion of how steam-detergent cleaning saves time and work and helps cut costs in connection with industrial mintenance operations is provided in an illustrated folder available from Oakite Products, Inc. The folder defines steam-detergent cleaning as the simultaneous application of *three* different actions: (1) the *physical* action of steam pressure and hot water; (2) the *dissolving* action of heat on oils, greases and other deposits; and (3) the *chemical* action of the detergent in penetrating, wetting, and emulsifying surface deposits. Oakite.

Circle letters (AJ) on reply card.

(AK) MEASUREMENTS CONTROL

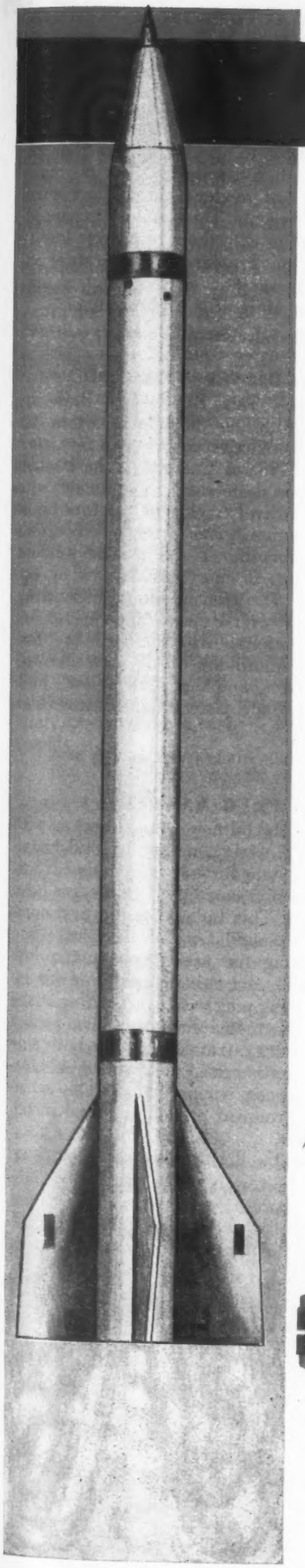
A new 24-page technical bulletin titled "Fundamentals of Industrial Electrochemical Measurements and Automatic Control—pH, Redox, Conductivity" is now available. Measurement of pH, redox, and conductivity in industrial control systems is comprehensively covered in this bulletin. Fundamental principles of electrochemical measurements as well as final control elements for automatic control systems are included. The company reports that it has attempted to present measurement and control background for electrochemical measurements in A-B-C language. Minneapolis-Honeywell Regulator.

Circle letters (AK) on reply card.

(AL) MOBILE RADIO

The RCA Service Company announced this week the availability of a new information brochure, which details its various service and parts protection plans for mobile communications systems. The four-page, illustrated booklet covers such service programs for mobile and microwave communications equipment as turnkey installation, installation supervision, and scheduled, and emergency service. RCA Service Company.

Circle letters (AL) on reply card.



MODERN FISHER® Improved LEVEL-TROL®

FOR LIQUID LEVEL CONTROL TRANSMISSION and INDICATION

Improved Feature

New level set adjustment. More highly visible.

Improved Feature

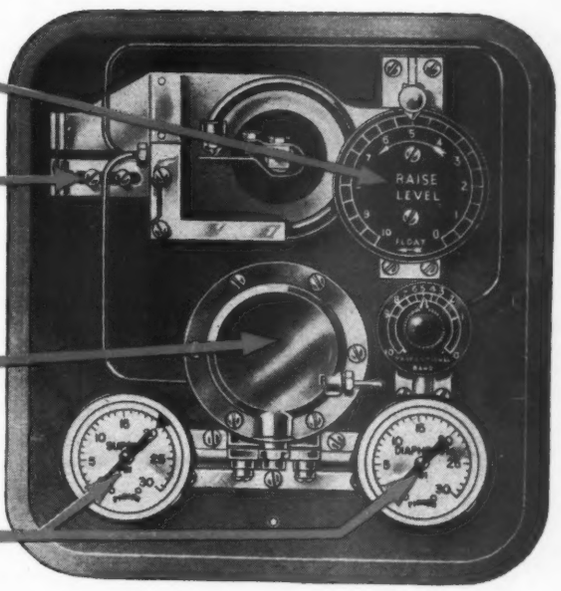
New factory calibrating adjustment makes possible accurate setting of proportional range over full float length.

Improved Feature

New relay—more compact—easily removed—easily assembled.

Improved Feature

Operating medium and diaphragm pressure gauges are glass-enclosed.



Type 2500-249 Level-Trol

• This improved Fisher Series 2500 Level-Trol is designed to better meet the requirements of field service—to give longer life—ease of maintenance. It still combines proportional range and specific gravity setting in one simple adjustment. Die cast weather—proof pilot case with black enamel finish, and improved lock hasp. Series 2500 Pilot Assembly is interchangeable with Fisher Series 2405 Pilot Assemblies now in service.

FISHER GOVERNOR CO.

MARSHALLTOWN, IOWA

To obtain more information on products advertised see page E-45

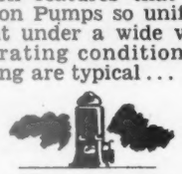
JOHNSTON CONSTRUCTION

gives you ***MORE***

for your pumping dollar

No other type pump can match Johnston Pumps for high efficiency . . . for adaptability to varying job requirements . . . for low maintenance and operating costs . . . for all-around ability to handle virtually *any* pumping application encountered.

Among the many construction features that make Johnston Pumps so uniformly efficient under a wide variety of operating conditions, the following are typical . . .



VERTICAL DESIGN—The motor head is at the surface where it can be serviced and lubricated easily. . . No costly foundations are needed. . . The pump unit is at the water level where it is always primed, ready to go.

OIL OR WATER LUBRICATION—Johnston Pump Company makes both oil- and water-lubricated pumps. Selection of the type is dependent on the type of installation and other factors Johnston engineers consider in making recommendations.

CHOICE OF IMPELLERS—Either bronze or cast iron Vitreous Enameled closed type impellers are furnished on Johnston Pumps. All controlling factors—well conditions, lift, capacity, pressure—are studied before one or the other is recommended. Semi-open type impellers are ideally suited to some conditions. They will not freeze or clog where the liquid contains gritty or pulpy matter. The clearance between impeller and bowl seat can be adjusted at the surface to suit the particular conditions under which the pump is operating.

For better vertical pumps, go to your local Dealer at the sign of the Johnston "J."
Johnston Pump Company, 2324 East 49th St., Los Angeles 58, California.

For complete information and the name of your nearby Dealer drop us a card.

(AM) CAST MONEL

The use of monel in the cast form has become increasingly popular for shapes difficult or costly to fabricate. In keeping with this interest, The Cooper Alloy Foundry Company has reprinted an 8-page booklet from the January 11th issue of Iron Age. Prepared by Norman S. Mott, chief chemist and metallurgist at Cooper Alloy, it contains information concerning the production of cast monel and the wide range of desirable physical and mechanical properties obtainable.

The Cooper Alloy Foundry Company.

Circle letters (AM) on reply card.

(AN) LABORATORY PUMP

A new bulletin has been published on the new Sigmamotor pump, which was developed to force liquids, solutions, or gases through tubing. The new tool, which will assist the chemical research worker and the process engineer, is not affected by solids in the solution. A series of fingers press against flexible tubing in sequence and impart a positive unidirectional movement to fluid in the tube. Rates of flow depend on speed of the "Sigmamotor", the dimensions of the tubing, and the external connections of the tubes through the pump. Either liquids or gases can be pumped. E and M Enterprises, Inc.

Circle letters (AN) on reply card.

(AO) WALL CATALOG

A new 12-page 2-color catalog on tube-supported walls for industrial boilers has just been made available. The catalog describes in detail how Bigelow-Liptak walls may be suspended directly from boiler tubes with resulting savings in steel and erection time. Engineering drawings show typical jobs and describe how the enclosure is fastened to the boiler tubes. Of particular interest is the inside spread which shows a series of photos of a job being erected.—Bigelow-Liptak Corporation.

Circle letters (AO) on reply card.

(AP) LIGHTNING PROTECTORS

An 8-page bulletin discussing light titled "Lightning Protection of Metal-clad Switchgear and Unit Substations Connected to Overhead Lines" is now available to the public. It was written by the Committee on Application of Lightning Arresters to Switchgear, General Electric Company. Diagrams, tables and pictures illustrate the comprehensive, detailed bulletin.

General Electric Company.

Circle letters (AP) on reply card.

(AQ) AUTOMATIC CONTROLS

The Mercoid Corporation has published a 64-page catalog listing all of its products and their prices. It features the Mercoid automatic pressure and temperature controls, which are adaptable to specific applications demanded by industry in its many phases of modern automatic control requirements. This catalog lists standard units with their respective low to high limit pressure or temperature operating ranges.

The Mercoid Corporation.

Circle letters (AQ) on reply card.

(AR) DIESEL TRACTORS

"Let's Talk Bulldozers—Built By Caterpillar" is the title of a new 16-page booklet recently issued by Caterpillar Tractor Company. The booklet explains how easy adjustments with "Cat" diesel track-type tractors boost production, gives brief specifications of Caterpillar diesel tractor models, and has a chart breakdown of optional D8 transmissions providing special reverse speeds for various job applications. Also included are featured highlights of the new No. 8U bulldozer, and the "Caterpillar" bulldozer blade. Caterpillar Tractor Company.

Circle letters (AR) on reply card.

(AS) PLUG VALVES

A colorful new manual packed with piping, wiring, mounting, and installation data for power operated Nordstrom lubricated plug valves has been issued. This bulletin is the first complete compilation of technical data covering the use of pneumatic, hydraulic, and electric operators for lubricating plug valves, according to the publisher. Included are typical piping diagrams, arrangements for both side and top mounted motor controls, closing speeds, wiring data, and an extensive group of photos of actual installations.

Rockwell Manufacturing Company.

Circle letters (AS) on reply card.

(AT) CAST STEELS

Two comprehensive brochures are available describing Lunkenheimer cast steels and copper base alloys, which will help solve piping problems and enable conservation critical materials by getting maximum service from equipment. This new metallurgical information deals with the basic problems of metal soundness, porosity, welding, graphitization, creep strength, new alloys, code conformance, and other subjects. The Lunkenheimer Company.

Circle letters (AT) on reply card.

(AU) CLAMSHELL BUCKETS

A new bulletin containing 42 pages of information on the maintenance and care of clamshell buckets has just been published by Blaw-Knox Division of Blaw-Knox Company. Included are suggestions on the proper use of clamshell buckets, with a list of common abuses to be avoided. Of particular interest to operating men is the section on bucket lips. What makes bucket lips bow in or bend out? There are descriptions for straightening distorted lips, together with detailed illustrated instructions on repairing fractures, hard surfacing cutting edges, and rebuilding worn cutting edges. "How to reeve the bucket for maximum efficiency" is another subject described in detail and illustrated for easy understanding. Blaw-Knox Division of Blaw-Knox Company.

Circle letters (AU) on reply card.

(AV) DRILLING RIG

The new Ideal Type 75-CA drilling rig, a 650-hp rig for medium depths, is described in Bulletin 372, announced by The National Supply Company. The bulletin contains 12 illustrated pages featuring construction and operation of the rig and includes specifications and diagrams showing shaft speeds and dimensions. National Supply.

Circle letters (AV) on reply card.

(AW) COOLING TOWERS

Two bulletins are available describing in detail Binks Manufacturing Company's new Dry-Fan cooling tower. These bulletins are Nos. 46 and 47, which give illustrations and pictures of the new towers. The company states that these towers, which are the blower type, are manufactured in two models. The 2-B Series is a single fan model available in 9 sizes, with capacities ranging from 3 to 30 tons of refrigeration. Binks Manufacturing.

Circle letters (AW) on reply card.

(AX) NEW VALVES

A new bulletin on Rollo valves for viscous liquids with solids has been announced by Worthington Pump and Machine Corporation. The Rollo valve cover is heavily constructed of drop-forged carbon steel, and acts as spring retainer and stop for the valve. The hole in hollow stem prevents trapping of liquid. The spring is corrosion resistant 18-8 stainless steel, ground flat on ends. It is available with a variety of spring tensions. Elimination of vanes and ribs in the seat opening permits pumping viscous liquids with a minimum pressure drop through the valves. Worthington Pump and Machinery Corporation.

Circle letters (AX) on reply card.

(AY) INDUCTION MOTORS

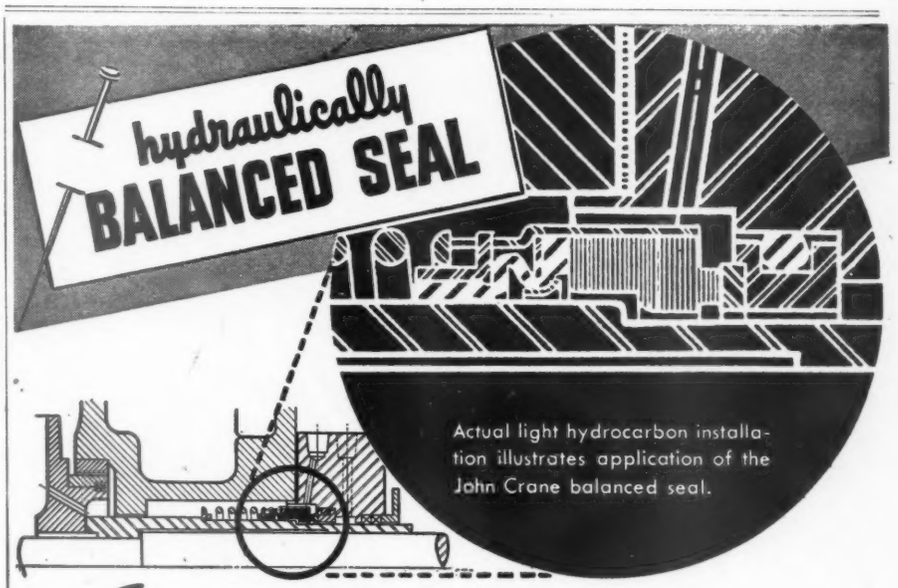
The large, polyphase induction motor, and where it fits into the industrial picture, is the subject of a new 28-page booklet (B-4739) available from Westinghouse Electric. The booklet presents a quick summary of the types and features of the two basic kinds of induction motors—Type CSF squirrel-cage motors for constant-speed drive, and Type CWF wound-rotor motors for adjustable-speed drive. Both types are available in a wide variety of open drip-proof enclosures. Westinghouse Electric.

Circle letters (AY) on reply card.

(AZ) FLOATING ROOF TANKS

Three types of floating roof tanks for product conservation and corrosion resistance are illustrated and detailed in Bulletin 51 F, recently issued by Hammond Iron Works. The company's double deck roof provides insulation of the entire surface of the liquid in the tank to substantially reduce the possibility of corrosion and product losses due to boiling, breathing, and filling. Their pontoon design floating roof is recommended for tanks having a diameter of 50 ft or more. Hammond Iron Works.

Circle letters (AZ) on reply card.


hydraulically
BALANCED SEAL
Actual light hydrocarbon installation illustrates application of the John Crane balanced seal.

Seals propane and other light hydrocarbons

"Service-Proven" on Refinery and Pipe Line Installations

The "John Crane" Type 1 Shaft Seal will mean outstanding sealing performance on practically all your petroleum services, *including the effective sealing of Butane, Propane and other light hydrocarbons.*

This seal is being widely used today for all general petroleum services—is suitable even for pressures to 500 psi.

It is a single unit and requires no auxiliary lubricating system. Proper balancing of sealing faces, and the selection of proper face widths for each job insure leak-proof operation.

Based on our wide refinery and oil field experience, we usually recommend the single balanced seal, as shown above, with perfect mating faces and with enough flexibility to allow plenty of axial and radial movement. Numerous installations have shown that any pump in good working order, using reasonably clean fluid, can be successfully equipped with this seal.

Proof of its unequaled service is found in its use by many major refineries. Practically all leading pump manufacturers, too, agree that this seal is the best means for sealing hydrocarbons. Most manufacturers furnish it as standard equipment.

Stocks of seals and packings are carried in our offices listed below. Our engineers in 32 branches are on hand to look after your service requirements.

JOHN CRANE

CRANE PACKING COMPANY

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(BA) DRAWWORKS BRAKES

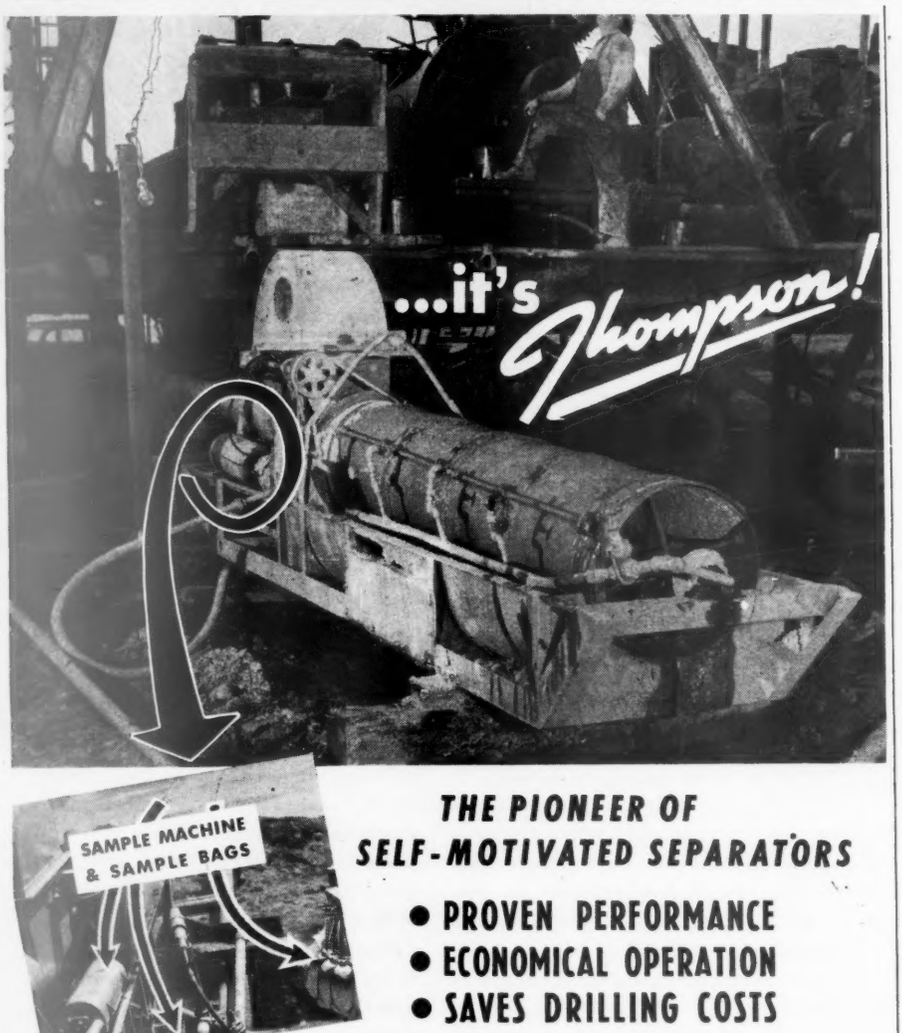
The Dynamatic Corporation has published a bulletin illustrating and describing its electro-magnetic drawworks brakes for oil field application. The bulletin also contains a section covering water cooled couplings for oil rigs. The electro-magnetic drawworks brake provides a retarding or braking effect that is variable and controllable through a range from 800 rpm to a drum speed slow enough to set slips on the heaviest strings of drill pipe or casing, without the assistance of the friction brake. The brake is adaptable to practically all drilling rigs. Water cooled couplings have also been developed by Dynamatic for use in place of friction clutches. Slip on couplings is adjustable from 100 to less than 3 per cent. Dynamatic Corp.

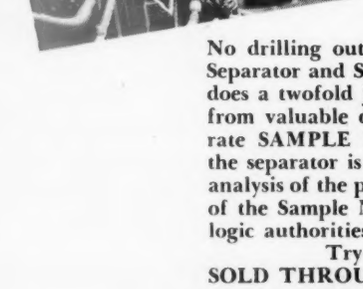
Circle letters (BA) on reply card.

(BB) CABLE TOOLS

A four-page bulletin listing magazines in which its advertising will appear has been published by Acme Fishing Tool Company. It also contains a post card for ordering the regular Acme tool catalog. Acme Fishing Tool Company.

Circle letters (BB) on reply card.





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No drilling outfit should be without a Thompson Shale Separator and Sample Machine. The Thompson Separator does a twofold job: (1) it removes the shale and abrasives from valuable drilling mud, and (2) the amazingly accurate SAMPLE MACHINE collects cuttings all the time the separator is operating to give an accurate foot-by-foot analysis of the progress of the well. The value and accuracy of the Sample Machine is recognized by drilling and geologic authorities as the best method of obtaining samples.

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THOMPSON TOOL CO.

IOWA PARK, TEXAS

(BC) ROCK BITS

Globe Oil Tools announces the publication of a new bulletin, No. 51-R illustrating and describing its complete line of "2-cutter" and "4-cutter" rock bits and the type of formation best suited for each. Globe bits are made in standard sizes up to 26 in for regular drilling and in 3¾ in. to 5⅝ in. sizes for geophysical work. Globe "4-cutter" rock bits are heavier. Weight is added to the body legs and provides maximum resistance to the twisting action of the drill string. Globe Oil Tool Company.

Circle letters (BC) on reply card.

(BD) SUCKER RODS

A 4-color, 40-page, spiral-bound bulletin, dealing with sucker rods and couplings, has just been issued by the D+B Division, Emsco Derrick and Equipment Company. It traces every step in the manufacture and processing of the rods and couplings; goes fully into detail regarding the metallurgy of each type of rod and the use for which it is best suited. It tells how to get longer life from D+B rod strings and describes the D+B engineering and field services available to users of D+B equipment. The bulletin is fully illustrated throughout with photographs, diagrams, cutaway views, micro-photographs, and line drawings that make it easy to follow each step in manufacturing and processing.

D+B Division, Emsco Derrick and Equipment Company.

Circle letters (BD) on reply card.

(BE) ROLLER CHAINS, SPROCKETS

A new catalog, RS-50, covering a full line of roller chains and sprockets from stock has been released by Whitney Chain. The catalog provides complete specifications and engineering reference tables on American standard roller chains, sprockets and attachments. Dimensional data, strengths, and weights are also supplied on allied products, such as block chain, cable chain, and flexible couplings. Whitney Chain.

Circle letters (BE) on reply card.

(BF) WATER COOLERS

Young Radiator Company, recently released a new 4-page, 2-color catalog on its improved line of engine jacket water coolers, said to be capable of withstanding the abuse of portable equipment installations. The catalog sets forth in detail the many new design features of the new units and describes accessories available as optional equipment. Young Radiator Company.

Circle letters (BF) on reply card.

(BG) POTENTIOMETERS

A new 36-page catalog has been published by Minneapolis-Honeywell Regulator Company covering its new electric control potentiometers. These new potentiometers, *ElectroniK*, are for both contact and proportional control. Engineering and constructional data, types of control, partial list of available ranges, application data, and accessories are fully described. Large black bold-face numerals on the strip chart are easily read at distances up to 60 ft, plus fine graduations which facilitate exact setting of the set point index. The indicating index is red and is constructed as an integral part of the pen carriage. Minneapolis-Honeywell Regulator Company, Brown Instruments Division.

Circle letter (BG) on reply card.

(BH) CHAIN DRIVES

New Whitney Catalog RO-51 shows how roller chain drives can be applied to a wide range of oil and drilling equipment to step up output and reduce costs. Comprehensive contents include details on exclusive Whitney oil field assembly lacing arrangement, chain illustrations, dimensions, and tables. Whitney Chain Company.

Circle letters (BH) on reply card.

(BI) SNATCH BLOCKS

American utility snatch blocks, toggle blocks, wrecker blocks, handi-winches, Crosby clips and wire rope sheaves are illustrated in a new specialized equipment catalog recently released by American Hoist and Derrick Company. Information to simplify ordering includes numbers, sizes, and capacities. Also included are pictures of the equipment in use. American Hoist and Derrick.

Circle letters (BI) on reply card.

(BJ) HEAT EXCHANGERS

Vogt film type heat exchangers are featured in that company's Bulletin HE-7. The company claims that these exchangers may be used even if dirty water must be used. They are of vertical, single tube-pass design with the water falling in a film on the inside surfaces of the tubes. Units are usually left open at the top and bottom, to allow tube side cleaning while in operation. The water enters in the open water-box flow on the top of the exchanger and discharges into a drain below. The film type flow and the proportioning of equal amounts of water to each tube is accomplished by the use of distributing ferrules. Henry Vogt Machine Company.

Circle letters (BJ) on reply card.

(BK) BLOCKS, SHEAVES

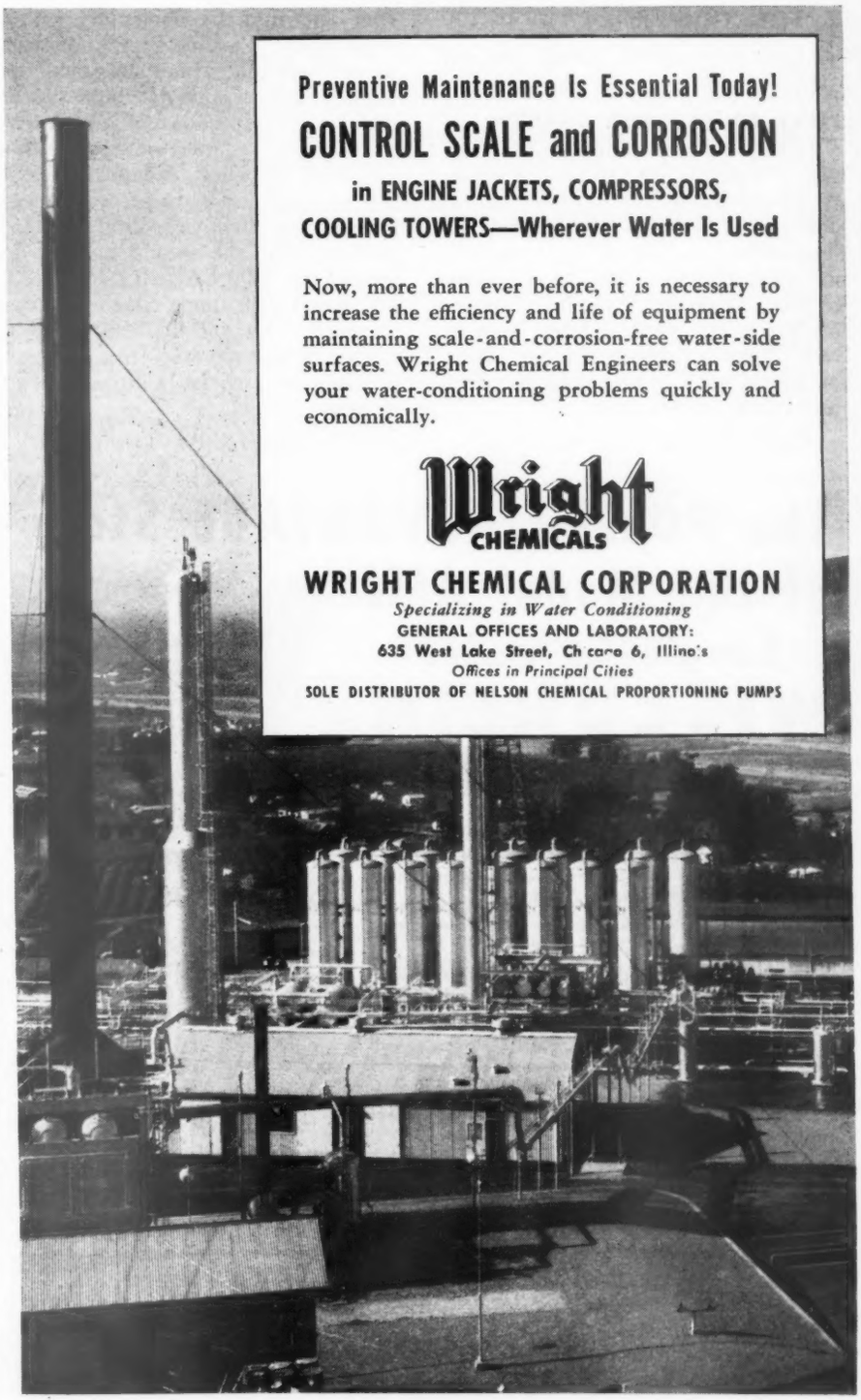
A new 24-page catalog describing the complete line of American blocks and sheaves has been announced by American Hoist and Derrick. Information includes block number, capacity in tons, number of sheaves, rope size and weight of each block. Also of interest to block and sheave users, a section on "How to figure line parts," the illustrations, ratio table, and formula included in this section will make reeving and line part figuring easy for riggers. American Hoist and Derrick Company.

Circle letters (BK) on reply card.

(BL) GATE VALVES

A 12-page, 2-color catalog on Pacific Valves' line of small size cast carbon steel gate valves has been made available to the public. These valves are of the 600 lb series and range in size from ¼-in. to 2 in. Three types of these gate valves are offered: The Bolted Bonnet type, O.S. and Y.; the Union Bonnet type, O. S., and Y., and the Union Bonnet type, inside screw. The bulletin contains charts showing material specifications for different types of valves, plus a price and dimension chart. Pacific Valves.

Circle letters (BL) on reply card.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(BM) WATER SOFTENERS

A new bulletin on hydrogen zeolite water softeners has just been published. This is a 16 page bulletin giving a complete description of the process and the field of application, showing the advantage of hydrogen zeolite softening and its relation to the sodium zeolite softening process. The hydrogen zeolite cation exchange process is relatively new (1935) while the sodium zeolite process has been in use in water softening since 1910. This Cochrane hydrogen zeolite softener bulletin is an exhaustive explanation not only of the process, but of the zeolites themselves and the details of the equipment used in the process. Cochrane Corporation.

Circle letters (BM) on reply card.

(BN) EXPANSION JOINTS

Zallea Brothers, announces publication of a new 4-page bulletin describing the complete line of Zallea expansion joints. Bulletin 351 gives sizes, dimensions, suggested applications and other technical data on a variety of joints from small flexible connectors for use on diesel exhaust lines to 30-ft diameter self-equalizing joints for use in such applications as wind tunnels, etc. Zallea Brothers.

Circle letters (BN) on reply card.

(BO) TUBULAR HEATERS

Petroleum heat processing, using radiant gas heat in tubular heaters, is the subject of a new bulletin issued by Selas Corporation. "Selas Gradiation Heater for the Petroleum Refining Industry" describes the heating principle that distributes radiant heat uniformly around and along the tubes. Selas Corporation of America.

Circle letters (BO) on reply card.

(BP) ROTARY PUMPS

Two bulletins have been published describing the Roper rotary pumps. Designated as the 3600 HBRV No. 7, one pump is rated at 300 gpm at 360 rpm and may be driven by geared head motor, gasoline engine, or truck power take-off. This pump has the venturi suction and discharged principle, which spreads the liquid over wide helical gears for smooth flow and high efficiency. A lattern ring in the packing box reduces pressure on packing for effective sealing and long packing life. The second bulletin describes the 3600 EAHBRV No. 2, 2A, 3A, and 4 with range capacities from 32 to 120 gpm, and the 3600 No. 5, 6, 7 with range capacities from 116 gpm to 340 gpm. George D. Roper Corporation.

Circle letters (BP) on reply card.

(BQ) PUMPS, HEAT EXCHANGERS

A 4-page, 2-color bulletin on the Nukem pumps and heat exchangers designed for rtansfer of corrosive liquids, hot or cold, has been published. The Nu-Kast Pumps are made of cast resins, and no metal comes in contact with the solutions. The stuffing box is completely eliminated, and transfer range is up to 100 gpm at varying heads. The Nukem-Karbate heat exchangers are light, compact units with short, straight runs, utilizing the acid resistance of non-metallic materials. These exchangers will raise solution temperatures 100 F. in 2½ hours, and may also be used for cooling purposes. Nukem Products Corporation.

Circle letters (BQ) on reply card.

(BR) DIESEL ELECTRIC SET

Design, operating, and performance features of the company's four largest diesel electric sets are presented in a new 16-page booklet recently issued by Caterpillar Tractor Company, Peoria, Illinois. Entitled, "Caterpillar Diesel Electric Sets," the issue deals specifically with the D397, D386, D375, and D364 engines. Power ranges from the 314-kilowatt D397 to the 165-kilowatt D364 (rated output) are outlined and the booklet offers information on these engines as to their easy adaptation for various jobs.

Circle letters (BR) on reply card.

(BS) AUTOMATIC VALVES

A fully illustrated, 40-page catalog on automatic valve operations was published recently by Nordstrom valves, Rockwell Manufacturing Company. Power operated valve installation is, to a great extent, an individual engineering problem, and this latest supplement to the regular catalog serves to aid in the installation of the valve. It contains complete piping, mounting, and wiring data for power operated valves. Rockwell Manufacturing Company.

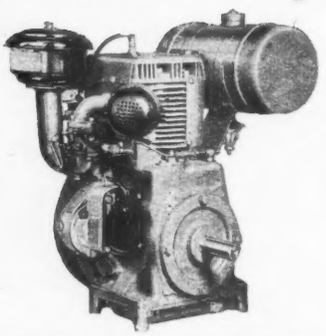
Circle letters (BS) on reply card.

(BT) ASSEMBLY CHAINS

A new catalog, supplying complete up to date data on Whitney oil field assembly chains is now available. This catalog describes the design features of "oil field assembly chain" and provides complete engineering reference tables on roller chains from ⅜ in. pitch to 2½ in., in single and multiple widths. In addition, it supplies helpful data on Whitney flexible couplings and Jeffrey chains for oil field service. Whitney Chain Company.

Circle letters (BT) on reply card.

The POWER ADVANTAGE Story of the Model AEN Single-Cylinder WISCONSIN *Air-Cooled* ENGINE



Here's more power . . . less weight . . . lower cost . . . all with no sacrifice in heavy-duty construction and serviceability in this Model AEN single-cylinder Wisconsin Engine. Features include:

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2. Self-cleaning tapered roller bearings at both ends of the crankshaft withstand either side-pull or end-thrust without danger to bearings.
3. Rotary type high tension OUTSIDE Magneto with Impulse Coupling operates as an entirely independent unit that can be serviced or replaced in a few minutes.
4. Maximum torque at usable speeds for equipment that really has to go to work.

Our engineering department will gladly cooperate with you in adapting Wisconsin Engines to your requirements. Write for detailed data and name of the nearest Wisconsin distributor.

CONDENSED SPECIFICATIONS

Bore	3"
Stroke	3¼"
Piston Displacement	23 cu. in.

HORSEPOWER

5.1 H.P. at 1800 R.P.M.
6.4 H.P. at 2200 R.P.M.
7.2 H.P. at 2600 R.P.M.
7.5 H.P. at 3000 R.P.M.

No. of Piston Rings	4
Fuel Tank Capacity	1.7 Gals

Weight, lbs.	Net	Crated
Standard Engine	110 lbs.	135 lbs.

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MILWAUKEE 46, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

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BOOKS

Bibliography on Management of Construction Jobs, *The Engineering Societies Library, 29 West 39th Street, New York 18, New York. Pages, 9. Price, $2.*

An annotated bibliography of 52 selected references to books and articles in periodicals that deal with construction job planning is made available in this booklet. Some of the titles pertain to: Work scheduling, costs, organization, preparation of material requirement charts, time studies, material and equipment control, and contracting procedures on various kinds of contracting and building jobs such as small and large-scale housing office and factory building, tunnel and highway construction.

Electronic Equipment Construction, *Terminal report, Phase I, Task Order No. 3, Contract N7onr-32103, placed by Office of Naval Research, Washington, D.C. Published by Office of Technical Services, Department of Commerce, Washington 25, D.C., Order PB 101 745. Price, $7.*

This report, compiled by Stanford Research Institute, is a survey and study of new objectives, techniques, and components applying to improved construction of electronic equipment. The report covers: Components, construction techniques, and research activities. The work, carried out as a preparatory phase of an investigation pointed to minimizing the maintenance required on present day military equipment, has been broadened to include any new information applicable to improving inherent reliability, miniaturization, and producibility.

The Origin of Red Beds, *by Paul D. Krynine. Transactions of the New York Academy of Sciences, Series II, Vol. 2, No. 3 (January, 1949). Pages, 9. Price, 25 cents.*

This pamphlet discusses red beds, which are formed under warm and moist climates, possibly in tropical savanna type climates. There is no connection between red color and aridity; the contrary is true. Tectonically red beds are connected with mostly positive movements and frequently are related to strong orogenesis and subsequent peneplanation.

Oil Field Exploration and Development (2-Vol. Set), *by Arthur Beeby Thompson, published by Anglobooks, 475 Fifth Avenue, New York 17, New York. Pages, 1176. Price, $20.*

Volume I of this book, entitled "Oil-Field Principles", is mainly devoted to problems involved in oil-field prospecting, the existence of phenomena associated with its occurrence and exploration, an account of the geographical and geological distribution of oil, the geology of chief oil fields of the world, a discussion of the origin of oil. The contents also include a detailed description of oil manifestations, with numerous illustrations, as well as the usual methods of calculating oil contents of pools, and predicting future yields and rates of depletion by graphic and other methods.

Volume II, called "Oil-Field Practices," deals with the development of oil-fields, commercial aspects of the industry, leasing problems and working customs, drilling methods and allied subjects, methods employed for the extraction of oil. There is an account of the projects being employed for increasing the recovery of oil by application of partial vacuum or the introduction of oil, gas, and water to partly exhausted beds.

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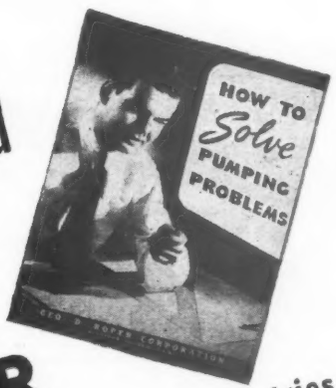

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Ira Rinehart's 1951 Yearbook, *Vol. 1 and 2. Published by Rinehart Oil News Company, P.O. Box 1208, Dallas, Texas. Price, $15.*

Ira Rinehart's 1951 yearbook, a compilation of many of the reports printed during the year 1950, contains much data on three divisions: Southeastern States, Rocky Mountain region, and Mid-Continent-Texas States. The subdivisions contain reviews, drilling statistics, new oil field discoveries, new extensions to established fields, and other pertinent oil data on 23 states. The volumes are illustrated with maps of important oil fields, and many charts are used. A record of payments on 302 common and preferred issues of oil and gas companies is listed, as well as other financial data.

Possible Future Petroleum Provinces of North America, *a symposium conducted by the American Association of Petroleum Geologists. Published by AAPG, Tulsa, Oklahoma. Pages, 257. Price: Non-members, $4; members, $2.50.*

This up-to-date description of America's undiscovered oil resources, is a symposium representing the work of 17 geological societies, 13 Federal, state, and provincial geological surveys, representatives of 33 oil companies, and 24 consulting geologists. A map showing the general geology and geography of each area and a cross-section, which brings out some of the chief stratigraphic and structural elements, accompany each of the province descriptions.

Petroleum Geology, *by Kenneth K. Landes. Published by John Wiley and Sons, Inc. Pages, 632. Price, $10.*

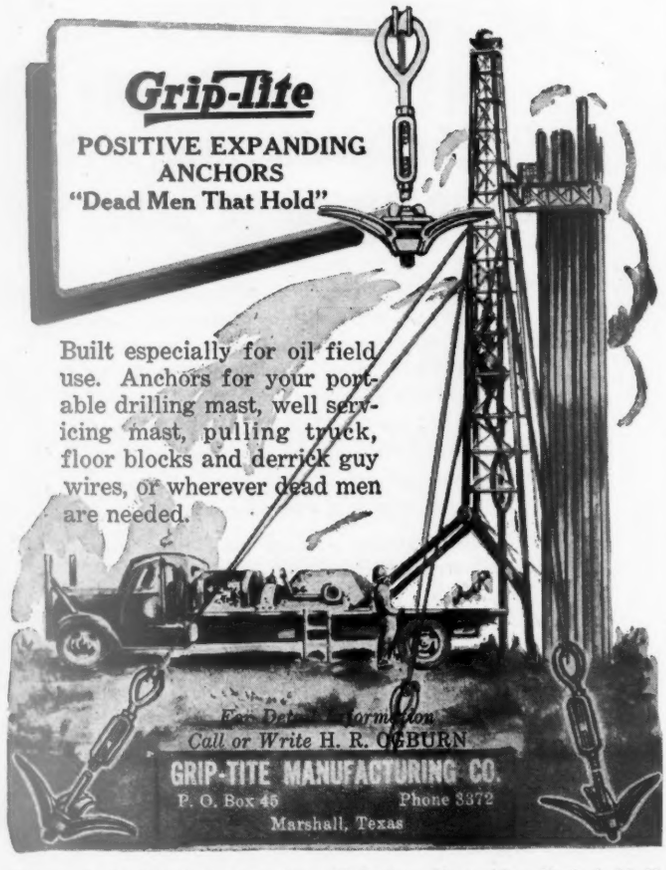
All three phases of petroleum geology—(1) geological occurrences of oil and gas deposits, (2) geographical distribution of oil and gas deposits, and (3) techniques for locating oil and gas deposits, are covered in this book. Newly discovered fields and other important information up to July, 1950, evaluation of theories explaining the origin of oil and gas, as well as the case study of method of studying traps, are covered in the text. Maps and illustrations indicate the distribution of oil and gas fields all over the globe, with important information on possible hydrocarbon sources of the future.

List of Publications of Bureau of Mines, With Subject and Author Index, *prepared by Hazel J. Stratton and Mabel E. Winslow. Published by Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Pages, 460. Price, $2.*

This Directory describes all the Bureau of Mines publications from July 1, 1910, when the Bureau was established, to January 1, 1949. It was felt that the index was necessary because the publications, covering a wide variety of subjects, and dealing with various phases of the minerals industry, are so numerous. The list contains subject and author index.

Liquid Extraction, *by Robert E. Treybal. Published by McGraw-Hill Book Company, 330 West 42nd Street, New York 18, N.Y. Pages, 393. Price, $7.50.*

In this new book of the McGraw-Hill chemical engineering series, all phases of the matter of unit operation of liquid-liquid extraction are covered. The physical chemistry of liquid-liquid equilibria, prediction of equilibria, thermodynamics of nonideal solutions, choice of solvent, diffusion in liquids, and a brief review of important modern chemical progress using liquid extraction, are a few of the subjects covered. Many diagrammatic illustrations are used to insure clarity of presentation, and detailed tables of notation and literature references are given, providing a basis for teaching in formal classes.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6. Allis-Chalmers Tractor Division
7. Aluminum Company of America
8. American Car & Foundry Company
9. American Hoist & Derrick Co.
10. American Manufacturing Company of Texas
11. American Meter Company Inc.
12. Attapulgus Clay Company
13. Axelson Manufacturing Company (Couplings)
14. Axelson Manufacturing Company (Plungers and Liners)

B

15. B and W Incorporated
16. Baash-Ross Tool Company
17. Baker Oil Tools, Inc.
18. Baroid Sales Division (Barawate)
19. Baroid Sales Division (Tannex)
20. Baroid Sales Division (Service Engineers)
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22. Bethlehem Steel Company
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C

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33. Cameron Iron Works (Valves)
34. Cameron Iron Works (Xmas Trees)
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36. Caterpillar Tractor Co.
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41. Continental Supply Company
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43. Core Laboratories, Inc.
44. Crane Company
45. Crane Packing Co.
46. Crutcher-Rolfs-Cummings, Inc.
47. Cummins Engine Company, Inc.

D

48. Dean Bros. Pumps Inc.
49. Dearborn Chemical Company
50. Dowell Incorporated (Anodes)
51. Dowell Incorporated (Acidizing Service)
52. Drilling & Service
53. Drilling Specialties Company
54. DuPont Company
55. Durametallic Corporation

E

56. Eastman Oil Well Survey Company
57. Emsco Derrick & Equipment Company
58. Enterprise Engine & Machinery Co.

F

59. Fairbanks, Morse & Co.
60. Farrel-Birmingham Company, Inc.
61. Fisher Governor Co.
62. Fluid Packed Pump Company
63. Fluor Corporation, Ltd. (Mathieson Process)
64. Fluor Corporation, Ltd. (Fin-Fans)
65. Fluor Corporation, Ltd. (Cooling Tower Repair)
66. Foster-Wheeler Corporation
67. Foxboro Company
68. Fram Corporation
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G

70. Garlock Packing Company
71. Gaso Pump & Burner Mfg. Co.
72. General Electric Company
73. Geolograph Co., Inc.
74. Glass Fibers, Inc.
75. Globe Oil Tools Company
76. Grip-Tite Manufacturing Co.
77. Grove Regulator Company
78. Guiberson Corporation
79. Gulf Oil Corporation
80. H & M Beveling Machine Co.

H

81. Halliburton Oil Well Cementing Co.
82. Hammond Iron Works
83. Harrisburg Steel Corporation
84. Hercules Tool Company
85. Hill, Hubbell & Company
86. Hilliard Corporation
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A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK	BL
BM	BN	BO	BP	BQ	BR	BS	BT	BU	BV	BW	BX	BY	BZ	CA	CB

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NAME..... Position.....
(Please Print)

COMPANY..... Address.....

CITY, ZONE..... STATE..... .....JUNE '51

94. Jergusan Gage & Valve Company
95. Johns-Manville
96. Johnston & Jennings Co.
97. Johnston, M. O., Oil Field Service Corporation
98. Johnston Oil Field Service Corporation
99. Johnston Pump Company

K

100. Koehring Company
101. Krome Co., Inc.

L

102. Lane-Wells Company (Bridging Plugs)
103. Lane-Wells Company (Koneshot)
104. Lane-Wells Company (Well Logging)
105. Lane-Wells Company (Packers)
106. Larkin Packer Company, Inc.
107. Levingston Shipbuilding Co.
108. Link-Belt Company
109. Lufkin Foundry & Machine Company
110. Lufkin Rule Company
111. Lummus Company

M

112. McCullough Tool Company
113. McEvoy Company
114. Magnaflux Corporation
115. Magnet Cove Barium Corporation
116. Manning, Maxwell & Moore, Inc. (Microsen)
117. Manning, Maxwell & Moore, Inc. (Valves)
118. Manzel Bros.
119. Mark, Clayton, & Company
120. Mathieson Chemical Corporation
121. Mercoid Corporation
122. Midwestern Engine & Equipment Co., Inc.
123. Miller Sand-Pump Co.
124. Minneapolis-Moline
125. Mission Manufacturing Co.
126. Morse Chain Company
127. Motorola, Inc.
128. Murphy Diesel Company

N

129. National Carbon Company
130. National Supply Company
131. National Supply Company (Spangseal Tubing)
132. Nicholson, W. H., & Co.
133. Nicolet Industries, Inc.
134. Nordstrom Valve Division

O

135. Oakite Products, Inc.
136. Ohio Injector Company
137. Oil Base, Inc.
138. Oil Center Tool Company
139. Oil Well Supply Company
140. Oklahoma Contracting Co.
141. Onan, D. W., & Sons Inc.
142. Otis Pressure Control, Inc.

P

143. Parsons Company
144. Patterson-Ballagh Division
145. Peerless Manufacturing Company
146. Pelican Well Tool & Supply Co.
147. Pelton Water Wheel Company
148. Penberthy Injector Company
149. Petro-Chem Development Co., Inc.
150. Petroleum Electric Power Association
151. Petroleum Engineering Associates
152. Petroleum Rectifying Company
153. Phillips Petroleum Company,
154. Pittsburgh Coke & Chemical Co.
155. Price, H. C., Co.

R

156. Radio Corporation of America
157. Reading, Pratt & Cady Valve Division
158. Rector Well Equipment Company
159. Reda Pump Company
160. Reed Roller Bit Company
161. Republic Steel Corporation
162. Ridge Tool Company
163. Rockford Clutch Division
164. Rockwell Manufacturing Company
165. Roper, Geo. D., Corp.

S

166. SKF Industries, Inc.
167. Schlumberger Well Surveying Corporation
168. Security Engineering Company, Inc.
169. Shaffer Tool Works
170. Shell Development Company, Inc.
171. Sinclair Research Laboratories, Inc.
172. Skinner, M. B., Company
173. Smith, A. O., Corporation
174. Spang & Co.
175. Standard Oil Company of California
176. Standard Oil Company of New Jersey
177. Superior Iron Works & Supply Co., Inc.

T

178. Thew Shovel Company
179. Thompson Tool Company
180. Tretolite Company
181. Trojan Construction Company
182. Tube Turns, Inc.

U

183. Ultra-Violet Products, Inc.
184. United States Rubber Company
185. Universal Atlas Cement Company
186. Universal Oil Products Company

V

187. Victaulic Company of America
188. Visco Products Company, Inc.

W

189. W-K-M Company
190. Weston Electrical Instrument Corp.
191. Whitney Chain Company
192. Wickes Boiler Co.
193. Williamson, T. D., Inc.
194. Wilson Foundry & Machine Co.
195. Wilson, Web, Oil Tools Inc.
196. Wisconsin Motor Corporation
197. Worthington Pump & Machinery Corp. (Pumps)
198. Worthington Pump & Machinery Corp. (Engines)
199. Wright Chemical Corporation
200. Wyatt Metal & Boiler Works

Y

201. Young Radiator Company
202. Youngstown Sheet & Tube Company

Z

203. Zeligson Truck & Equipment Co.
204. Zink, John, Company Perco Division

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COMPANY..... Address.....

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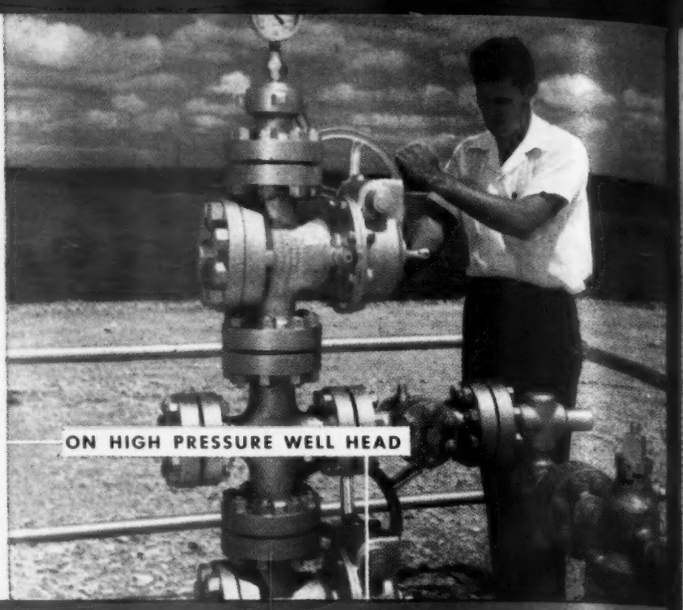

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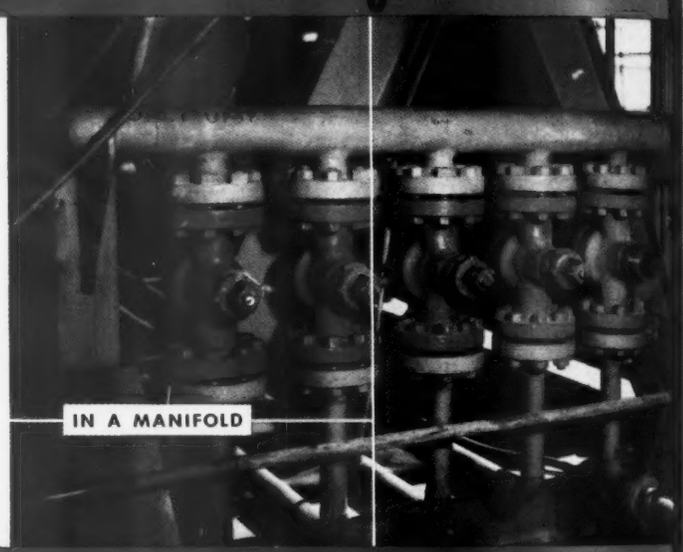
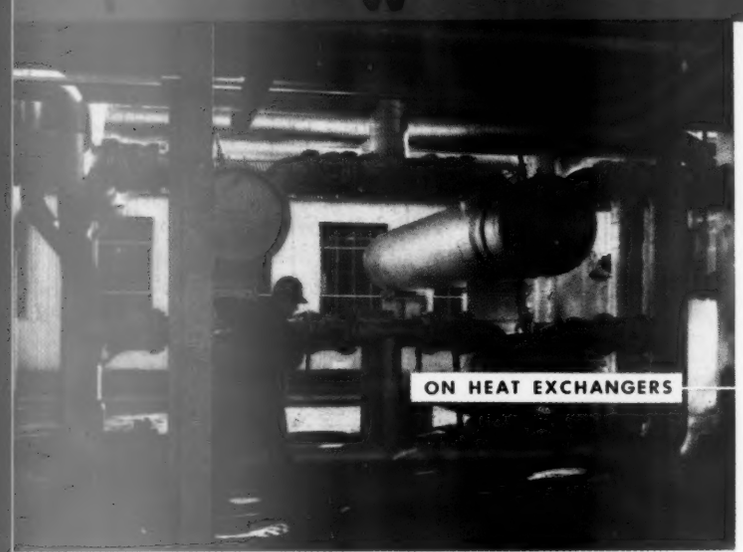
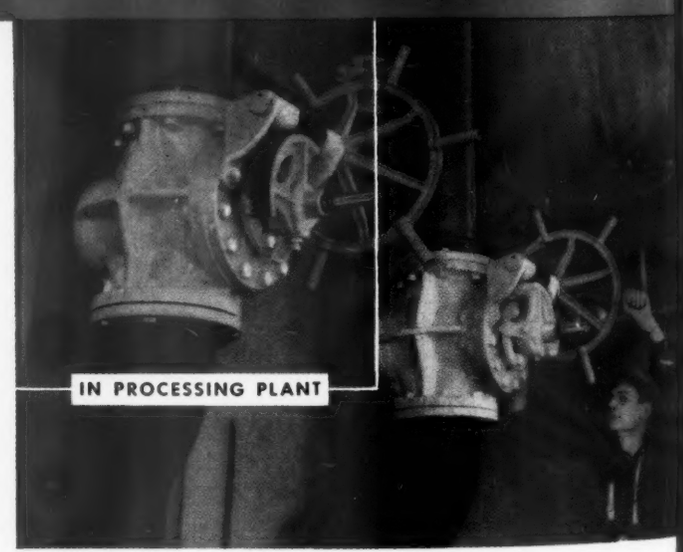


Replace ineffective valves with **NORDSTROMS**





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March 26-30, 1950

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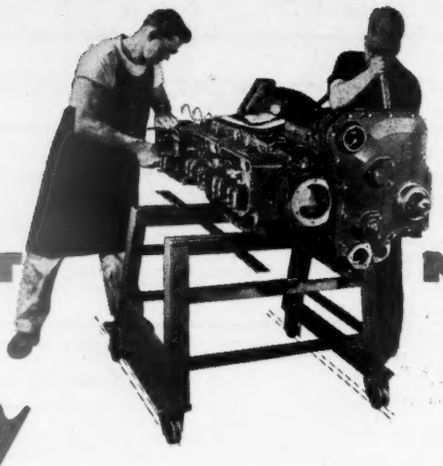

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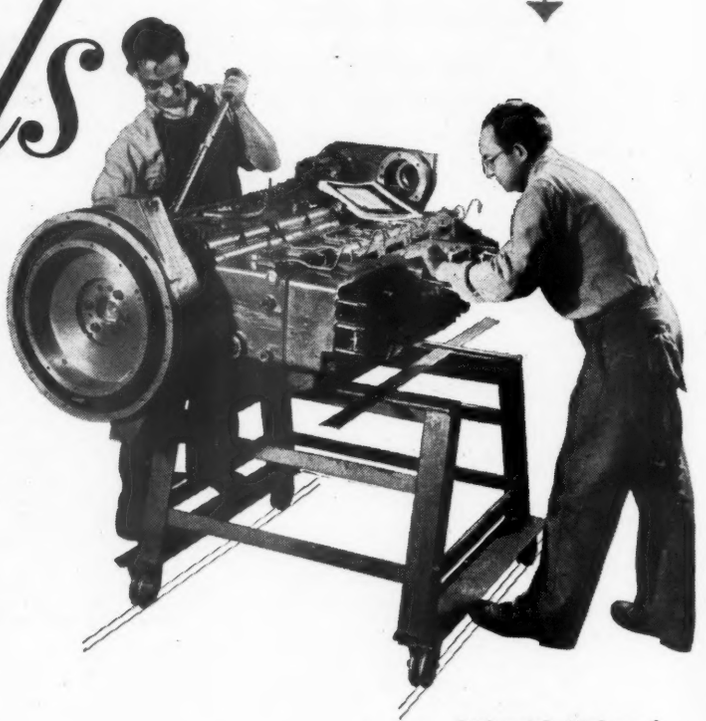

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May 13-16, 1951

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American Institute of Mining and Metallurgical Engineers

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New Orleans, Louisiana
October 4-6, 1950

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Further Developments in the Laboratory Determination, of Relative Permeability, B. H. Caudle, R. L. Slobod and E. R. Brownscombe
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October 12-13, 1950

Applications of Differential Thermal Analysis to Reservoir Problems, P. C. Romo
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Iranian Gums as Treating Agents for Drilling Fluids, George Tchillingarian and Carrol M. Beeson
Mineralogical Studies of California Oil-Bearing formations. I. Role of Clays—Methods of Analysis, W. C. Merrill, A. Grenall, and P. G. Nahin
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Hotel Statler
St. Louis, Missouri
February 17-22, 1951

An Analysis and the Control of Lost Circulation, George C. Howard and P. P. Scott, Jr.
An Experimental and Theoretical Investigation of Gravity Drainage Performance, P. L. Terwilliger, Howard N. Hall, L. E. Wilsey, P. M. Bridges, and R. A. Morse
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Water Flooding in the Illinois Basin Area Yesterday, Today and Tomorrow, H. S. Barger
World Oil and Gas Developments, (presented by the 1950 and 1951 Production Review Committees)

American Petroleum Institute

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Pacific Coast District
Division of Production
Biltmore Hotel
Los Angeles, California
May 11-12, 1950

Development of Blowout Prevention and Controls, Bert L. Stone
Economic Trends of Contract Drilling in California, R. A. Powell
History of Kettleman Hills, Temblor Zone Gas Injection Project, D. R. Knowlton and R. W. Masters
Oil Around the World, T. S. Petersen
Relative Permeability of California Cores by the Capillary Pressure Method, John I. Gates and W. Tempelaar Lietz
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Summer Meeting
Lubrication Committee
Marketing Division
Detroit, Michigan
June 14-15, 1950

Servicing Automatic Transmissions, G. A. Round

Products Pipe Line Technology Conference
Hotel Lennox
St. Louis, Missouri
September 11-13, 1950

A Development in Metering Practices, Norris Plank
Application of Inhibitor in Products Pipe Line Operations, F. M. Watkins
Economics of a Pipe Line Design, R. H. Lynch
Emergency Fire Fighting Equipment for Products Pipe Line Stations and Terminals, R. T. Henderson
Fully Automatic Pipe Line Pumping Stations, H. E. Fisher
Ideas in Mobile Transportation and Maintenance Equipment
Mechanical Seals for Main Line Pumps, W. G. Horstman
Operational Costs, Diesel versus Electrically Operated Units, C. C. Keane
Procedures in Cutting, Tapping, Maintaining and Repairing Leaks in Field Pipe Lines Handling L.P.G. Products, G. T. Jennings
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The Use of Microwave for Pipe Line Communications, E. B. Dunn

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Ambassador Hotel
Los Angeles, California
November 13-16, 1950

Building a Greater America, Lewis A. Pick
Business and Education: An Indissoluble Partnership, Fred Fagg, Jr.
California Oil, R. L. Minckler
Conservation and Property Rights, George W. Hazlett
Developments in Internal Pipe-Coating Techniques, J. K. Alfred
Developments in Large-Diameter River-Crossing Construction, F. Hill Sanders, Jr.
Establishing and Maintaining an Effective Fire-Control and Safety Program, J. H. Myers, R. W. Black, C. L. Hightower, W. O. Wilson, and J. H. McKenzie (Panel Discussion)
Fuels and Lubricants Trends for Army Equipment, Benjamin S. Mesick
Heavy-Duty-Engine Lubricating Oils, W. C. Latrobe
How API Code 25 Can be Improved, G. H. Supple and R. Charles Nicholson
Implications of Multi-Pump Reselling, B. E. Devere
Keep It Pasted Up, Jake L. Hamon
New Developments in Coatings and Cathodic Protection, Carlton L. Goodwin
Oil, Gas, and the Banker, Fred F. Florence
Oil in the Far East, William E. V. Abraham
Opportunities for Petroleum in the Energy Markets of the Future, Chester F. Smith
Optimum Use of Coring, Electric Logging, and Other Testing Methods in Exploratory Wells, John E. Walstrom
Our Responsibility to the American People in Peace and in War, Bernard L. Majewski
Prediction of Surge Pressures in Long Oil-Transmission Lines, Milton Ludwig and Sidney P. Johnson
Recent Developments in Product Pipe-Line Technology, H. E. Fisher
Strategic Oil Supplies, Gustav Egloff
Synthetics in Defense, James Boyd
Tax Policy and Petroleum Supplies, Hines H. Baker

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By Subject

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(Continued from May, 1951)

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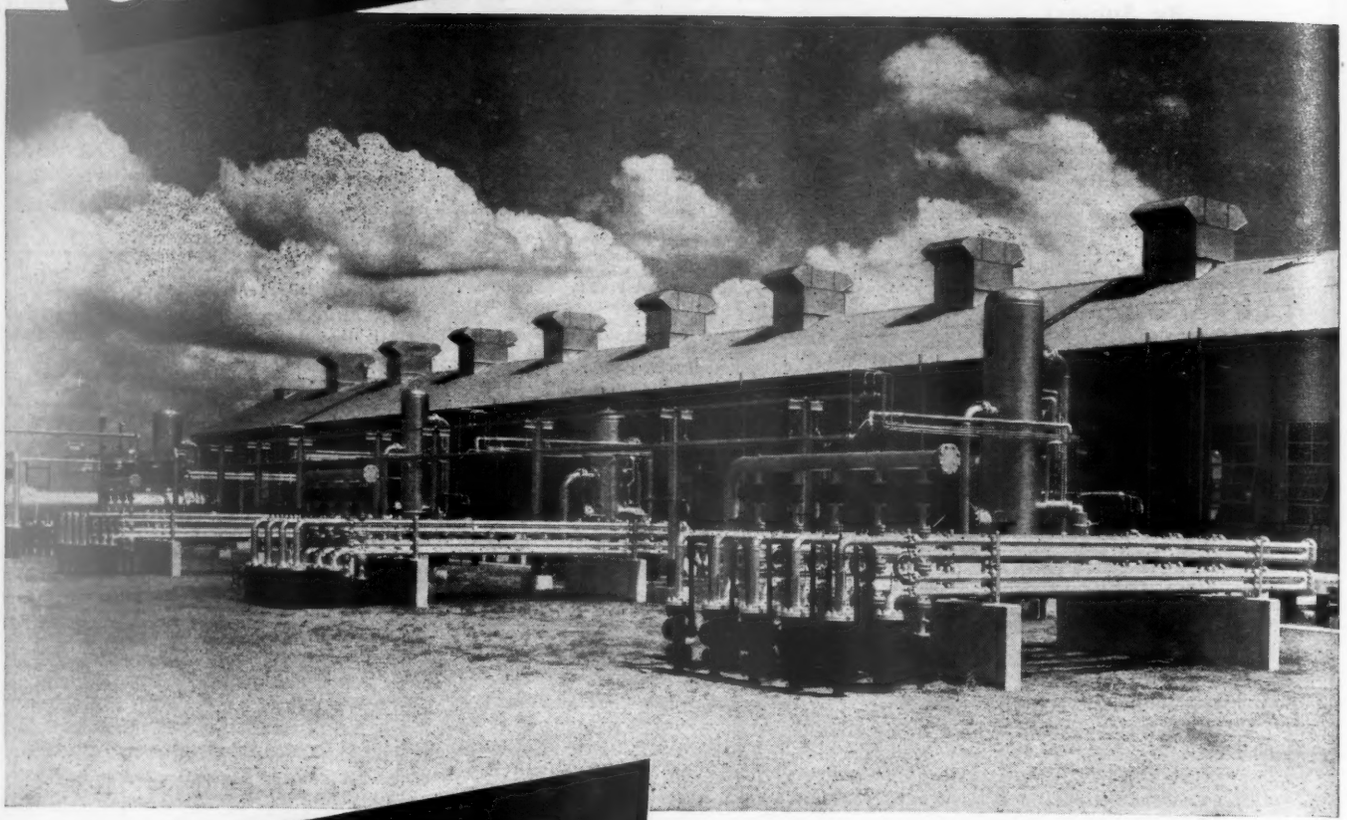

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The sections can be used in one bank after another — on different duties — and different products. A bank can even be broken up and the sections shipped to two or more plants, miles apart, re-assembled and reused. Sections not in use serve as "stores" for other sections on stream. They are never obsoleted by changes in duty or plant re-arrangements. You can use and reuse them until they are completely worn out. Estimates and quotations furnished promptly. ***Write for Bulletin No. 481.***

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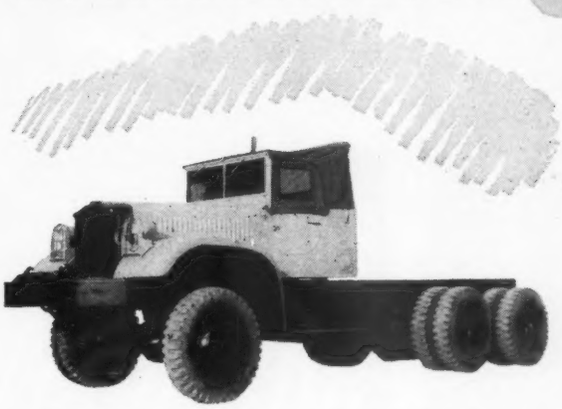
TRUCK PERFORMANCE WITH "FACTORY-PROCESSED" NEW-GUARANTEED 6x6's

International 6x6 with 361 cu. in. Red Diamond engine, 5-speed Fuller transmission, Hendrickson tandem, 8.25x20 M & S tires.

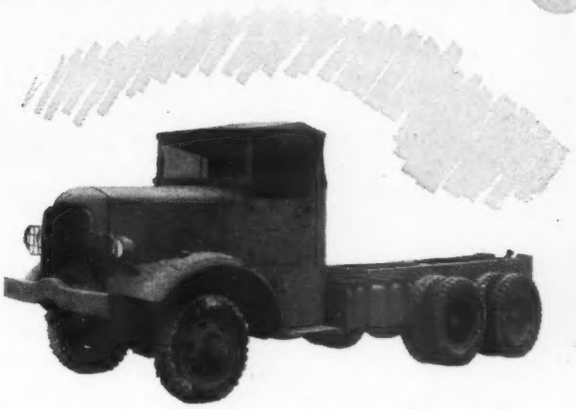
"Factory-Processed" trucks from Zeligson are the cream of the Army Surplus trucks that were preserved in Government storage. Chassis and engine are completely disassembled in our modern shops by skilled mechanics and technicians; and the complete truck is reassembled to factory specifications.

Like many other contractors you will discover that only TANDEM ALL-WHEEL-DRIVE trucks will insure greater DEPENDABILITY on the highway or in the field, despite terrain and weather conditions which cause delays with single-drive equipment.



Diamond-T 6x6 with 529 cu. in. RxC Hercules engine, 5-speed Clark transmission, Timken tandem, air brakes, 9.00x20 M & S tires.

GMC 6x6 with 270 cu. in. GMC engine, 5-speed Clark transmission, Timken tandem, 7.50x20 M & S tires.



NM Mack 6x6 with 707 cu. in. thermodyne engine, 5-speed Mack transmission, Timken tandem, air brakes, 10.00x22 M & S tires.

Half cabs are available on above trucks for crane mounting.

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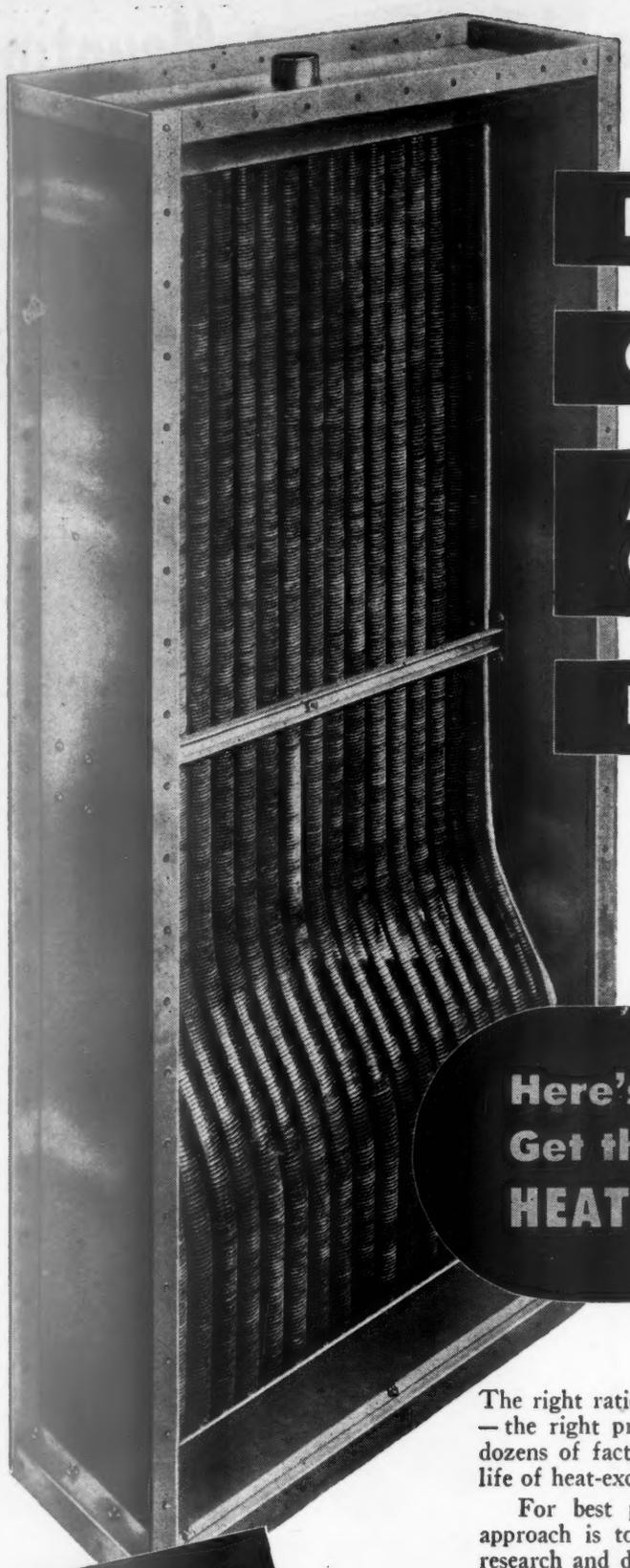

Heating?

Cooling?

Air Conditioning?

Process?

Here's How to Get the RIGHT Answer to your HEAT-EXCHANGE PROBLEMS

The right ratio of surfaces – the right materials – the right velocities – the right proportion between coil area and depth . . . there are dozens of factors that affect the efficiency, maintenance and service life of heat-exchange coils.

For best performance in your own application, the practical approach is to take full advantage of the unequalled engineering, research and design skill – the unequalled manufacturing and testing facilities – which Aerofin offers you.

To get the *right* answer – ask the Aerofin man.

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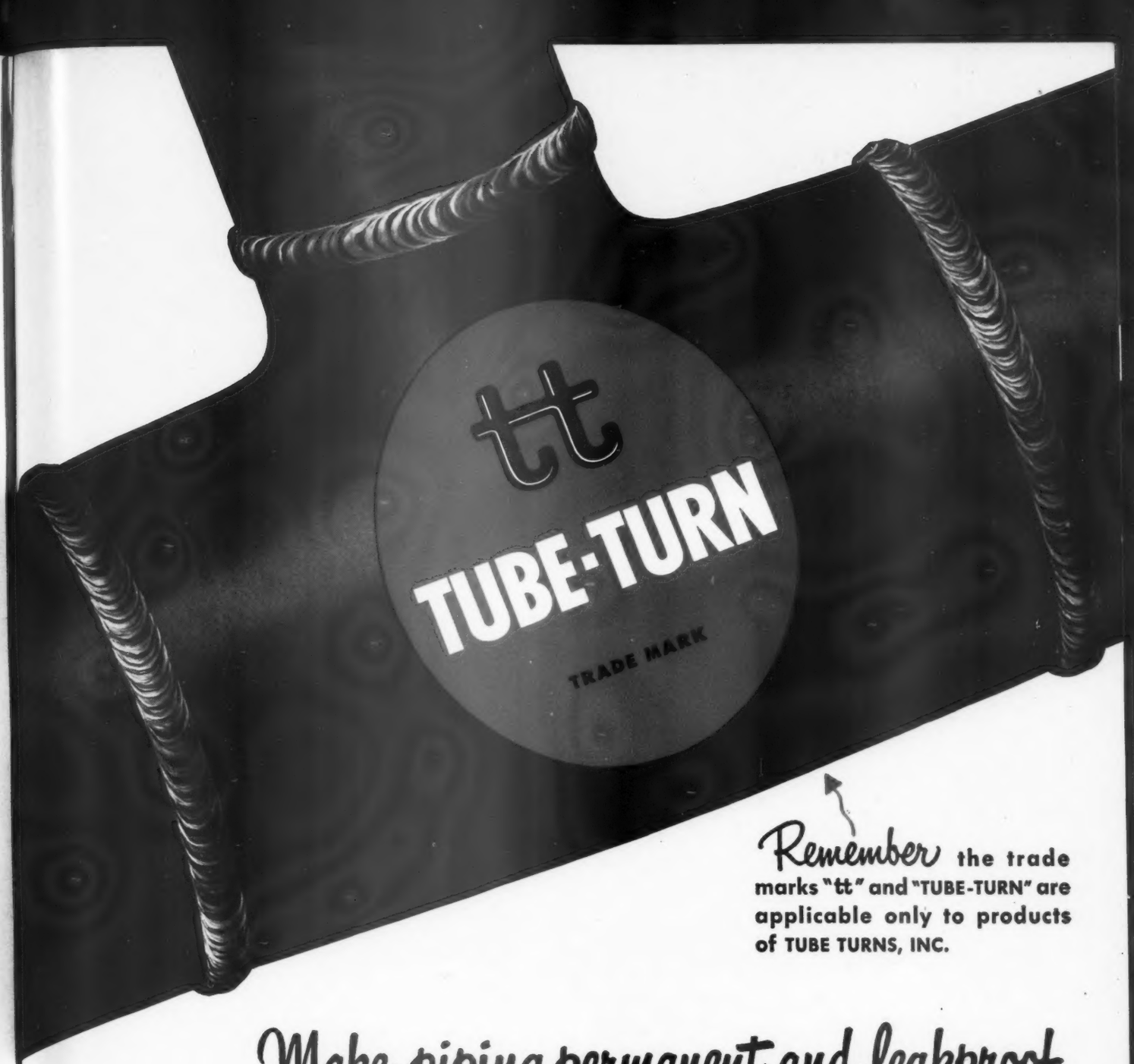

Remember the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

Make piping permanent and leakproof

Write Dept. K-6 for free booklet listing properties of pipe and welding fitting and flange materials.

PIPING PERMANENCE is always important but now, more than ever, any installation of piping should be leakproof, maintenance-free and have extra long life. A piping system, big or small, is only as strong as its weakest component. That's why welding fittings, for example, should be specified with care.

TUBE-TURN Welding Tees are drawn from seamless tubing to a barrel shape—the shape every tee wants to assume under pressure. This feature, together with the generous crotch radius and thickness, explains why TUBE-TURN Welding Tees withstand more pressure without yielding. Bursting pressures obtained in tests of representative fittings have averaged more than 25% higher than required by standard codes. Here's extra quality at no extra cost.

Get in touch with your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

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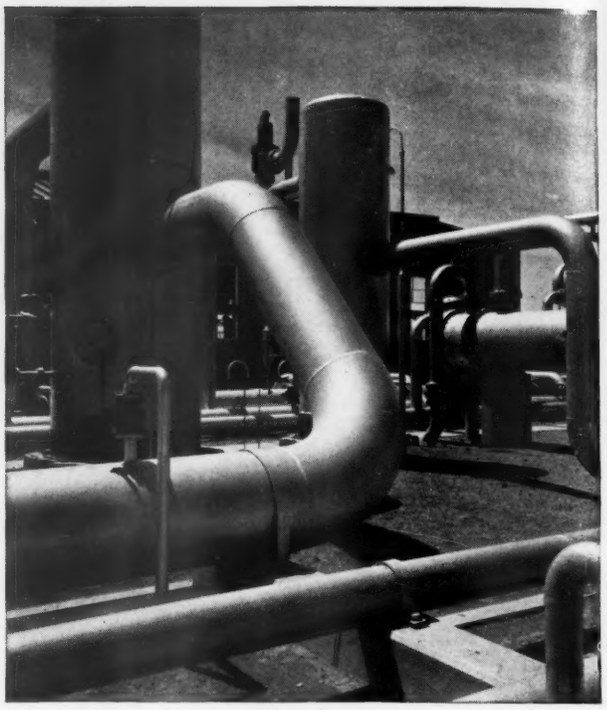
TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO... A wholly owned subsidiary of TUBE TURNS, INC.

Piping fabricators economize with TUBE-TURN Welding Fittings

Ingenious fabricators cut two 180-degree TUBE-TURN Welding Returns in half, welded them together to make this unconventional expansion joint. It's being installed in a location where space is at a premium.



Pressures in this gasoline plant piping are high, but lines welded with TUBE-TURN Welding Fittings are permanent and leakproof. Each fitting is given no less than 15 visual and instrument inspections during manufacture.

Here a 45-degree TUBE-TURN Elbow was cut to an odd angle, then matched perfectly with the pipe. Welders know they can count on true circularity with TUBE-TURN Welding Fittings—an important advantage in the field.

Variety of TUBE-TURN Welding Fittings makes fabrication swift and easy. Tube Turns, Inc. has the world's most extensive line of welding fittings and flanges.

Want materials data?

Tube Turns, Inc. has prepared a booklet listing properties and specifications of pipe and fitting materials—carbon steels and wrought iron; stainless steels; nickel and nickel alloys; etc. If you'd like a free copy just send this coupon.

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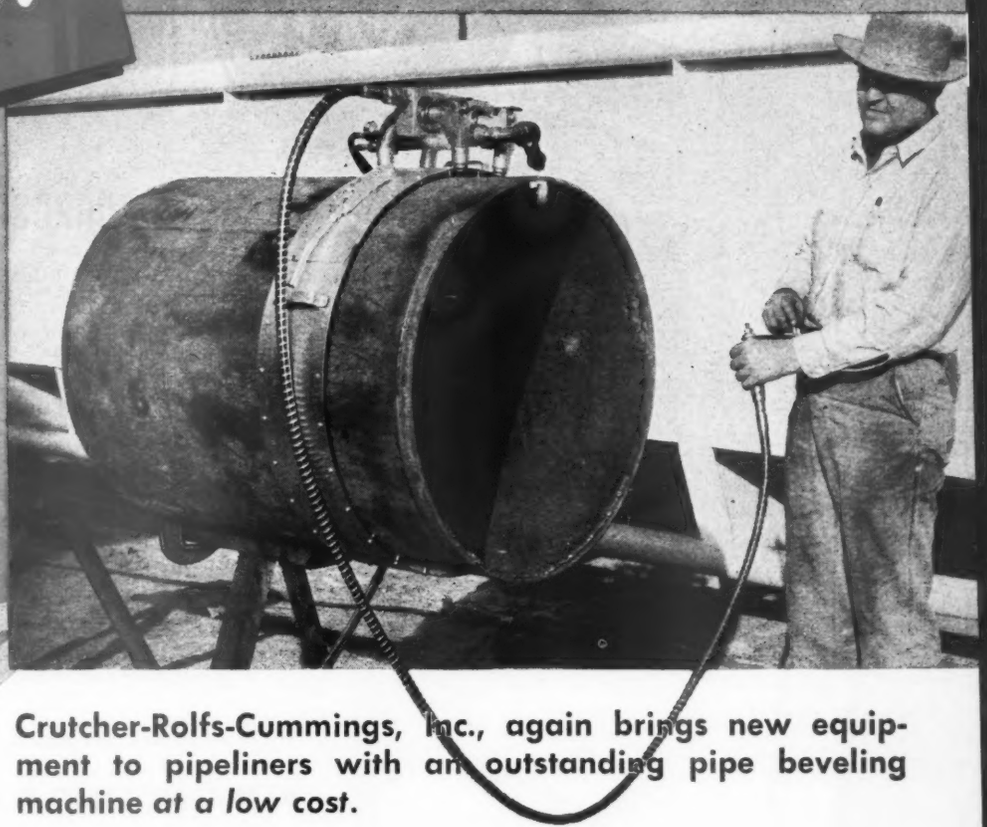
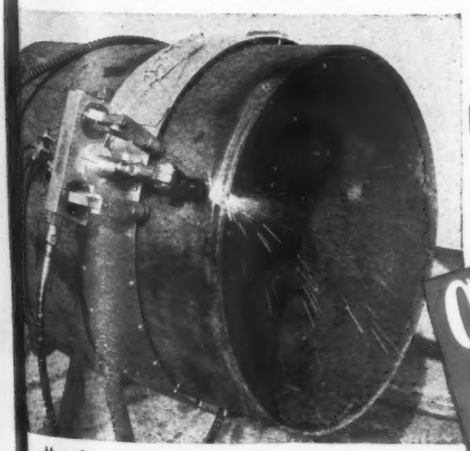
NEW Simplified PIPE BEVELER BY C-R-C BEATS OLD PROBLEMS

Check these important features



Crutcher-Rolfs-Cummings, Inc., again brings new equipment to pipeliners with an outstanding pipe beveling machine *at a low cost.*

- ***Light Weight:*** Beveler, complete with band for 30" pipe, weighs approximately 35 pounds.
- ***Cuts out-of-round pipe without additional attachments:*** Flexible spring steel bands conform to out-of-round pipe as well as perfectly formed pipe.
- ***Always makes a perfect and complete square cut:*** Flexible band is positively locked in a true position around the pipe and torch tip is always the same distance and angle from the pipe.



Manufactured by Industrial Machine Company, Oklahoma City, Oklahoma, exclusively for C-R-C.
Patent Pending

- ***Eliminates any irregular cuts at seam:*** When the cut is made it requires no grinding or dressing to prepare for weld. The pipe is ready for welding when the beveler is removed from the pipe.
- ***No large "bell hole" required:*** A "bell-hole cut" can be made in a standard ditch with a little additional excavation. The beveler requires only 6" to 8" clearance around the pipe.
- ***Beveling time cut to a minimum:*** The light-weight beveler can be set up on the pipe by ***one man,*** cut made and removed from the pipe in a fraction of the time required by other bevelers.
- ***Simple setup and operation:*** The band is either slipped over the end of the pipe or opened and put around the pipe, then latched with a throw handle. The beveler is then snapped on the band with two thumb latches, the torch lighted, and the driveshaft handle turned to make the cut.
- ***Operated safe distance from pipe:*** Nine-foot flexible drive shaft enables operator to make cut without standing immediately over torch.
- ***Single beveling unit:*** Operated on any size band from 8" to 36".
- ***Bands require only small space for transporting:*** A complete set of bands for 8" to 36" pipe may be "nested" to take up a minimum of space where various sizes may be required.
- ***Savings in cost of equipment:*** The complete equipment to handle a range of pipe sizes from 8" to 36" costs far less than any other type of beveling equipment.

18 Years Pipe Line Construction Experience

C-R-C

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Pipe Line Equipment and Supplies
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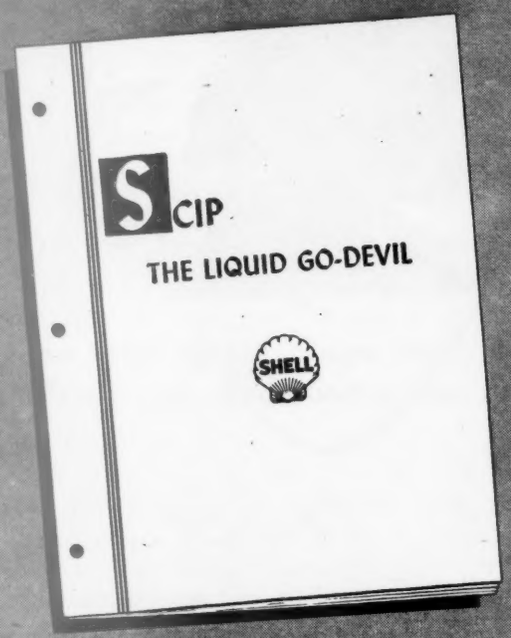
There's no Match for C-R-C Equipment PLUS C-R-C Service and Experience

SCIP*

* SHELL CORROSION INHIBITOR PROCESS

(patented)

Banishes corrosion from product pipe lines



This booklet tells all about SCIP. Mail coupon for your copy.

- **PREVENTS CORROSION ON NEW LINES**
- **CLEARS SCALE FROM OLD LINES**
- **MAINTAINS FULL CAPACITY FLOW**
- **HAS NO EFFECT ON PIPED PRODUCTS**
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Products amounting to *many millions of barrel-miles per day* are now transported at full capacity in pipe lines kept free from scale by SCIP. The dollars-and-cents savings pay for a SCIP installation many times over in the course of a year's operation. If your lines are not delivering full capacity because of corrosion, be sure to fill out and mail the coupon for Shell's booklet, "SCIP, The Liquid Go-Devil."

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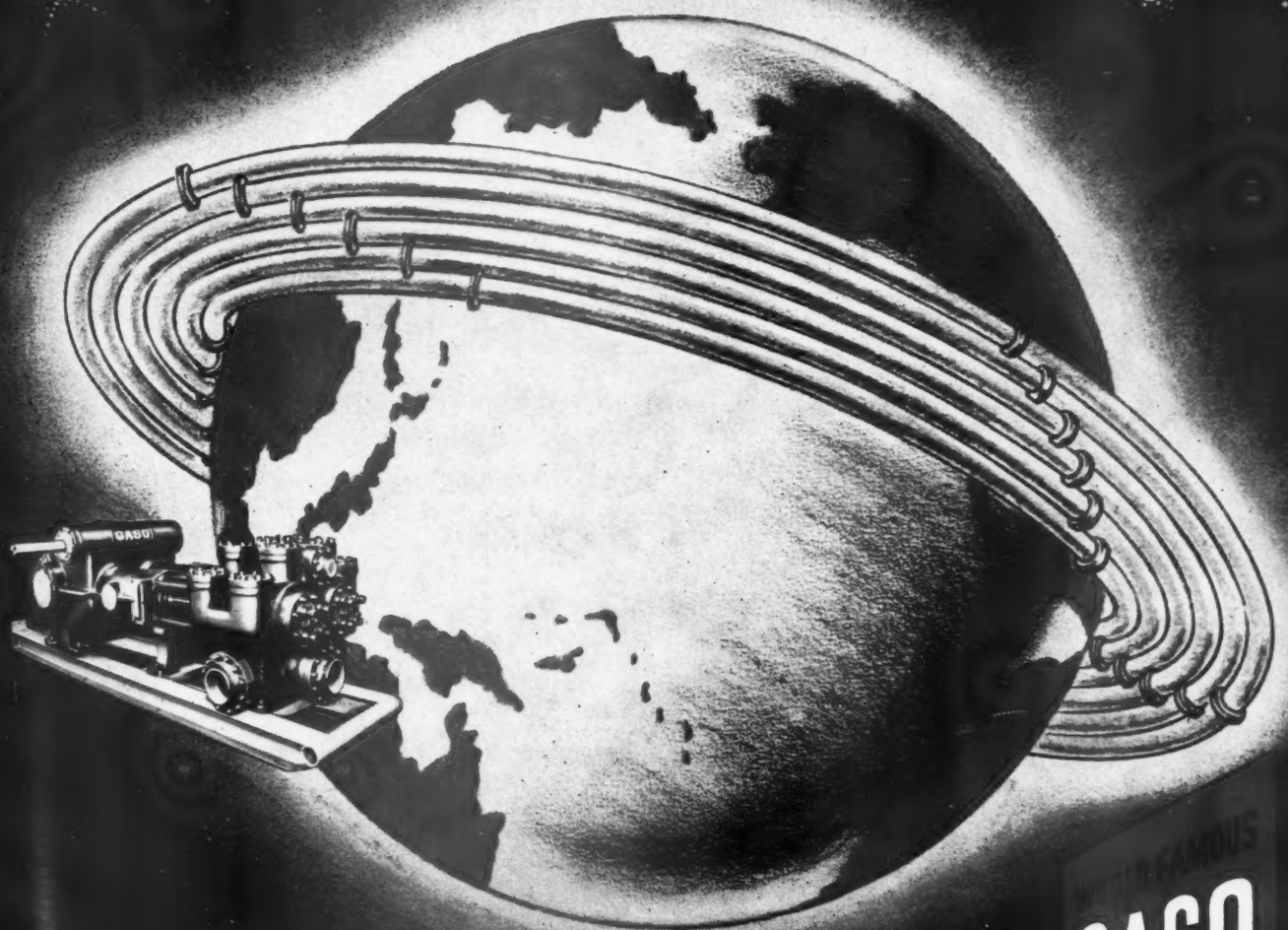

★ In 1865 completion of a successful four-mile line marked the beginning of the pipe line industry. Today, more than 156,000 miles of line help to keep the cost of petroleum products down, and to bring their benefits to people everywhere. That's enough pipe to encircle the globe six times. It's stimulating to be part of this picture, gratifying to be recognized as the industry's leading source of portable pumping units.

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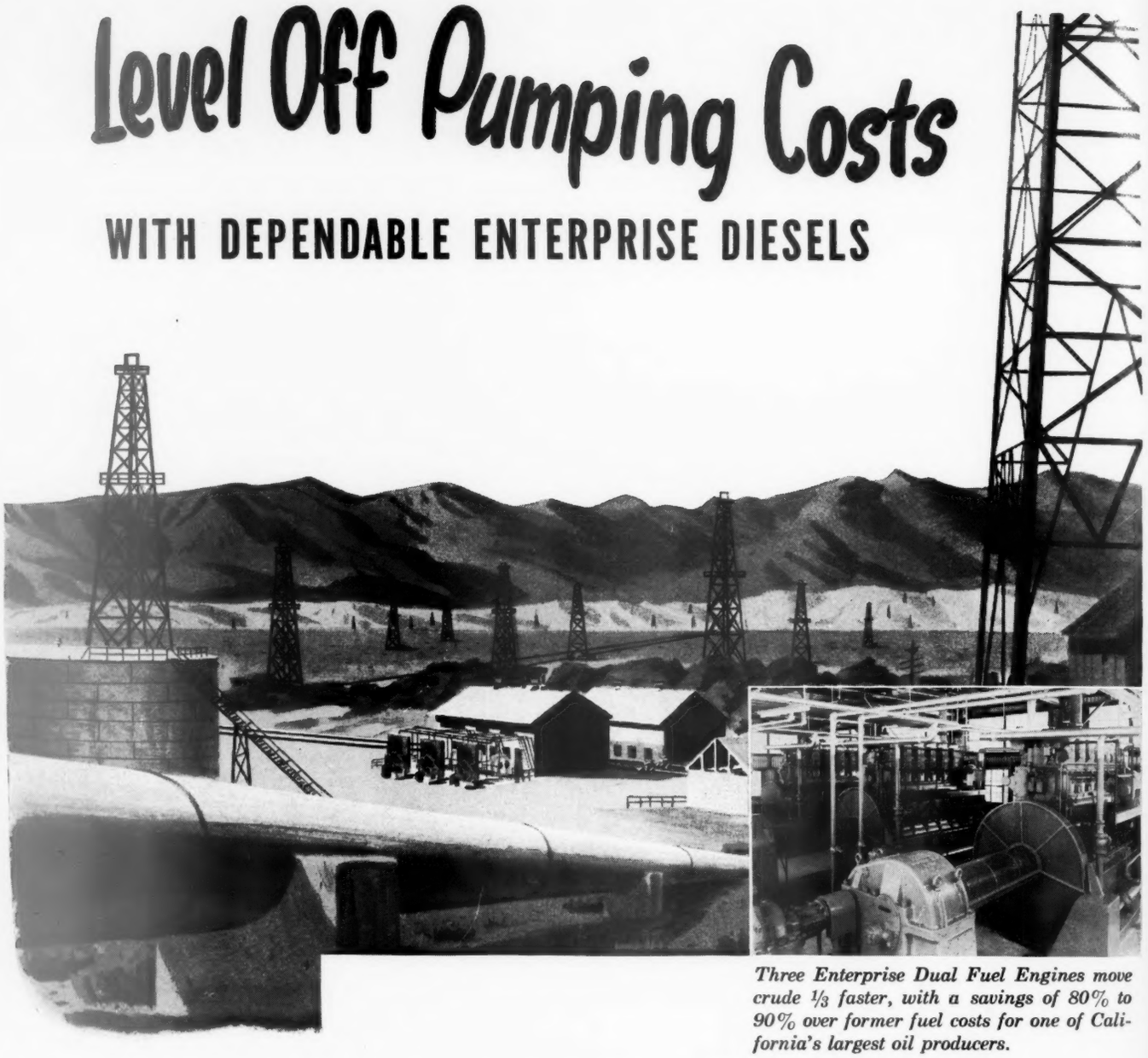
Level Off Pumping Costs

WITH DEPENDABLE ENTERPRISE DIESELS



Three Enterprise Dual Fuel Engines move crude 1/3 faster, with a savings of 80% to 90% over former fuel costs for one of California's largest oil producers.

Enterprise Diesels, Dual-Fuel and Spark Ignition Gas Engines, stationary and portable, are built in a wide range of models from 68 to 1755 HP. Generator sets to 1250 KW. Turbocharging available on most models.

Rugged and reliable, Enterprise Diesels are designed and built to cut power costs all along the line—from drilling rig to pipe line terminal. Modern installations of these medium and slow speed diesels are providing exceptional pumping service on a continuous, round-the-clock basis. Contributing to their high economy of operation are 1) simplicity of connection and control, 2) high torque at all speeds, 3) elimination of transmission losses, 4) adaptability to crude and residual fuels, and 5) smooth, vibration-free operation—even under excessive load. They provide the flexibility that's needed, too, using Diesel oil, crude, natural gas or dual-fuel. For *your* next diesel power job, investigate Enterprise—better built for longer life at lower costs.

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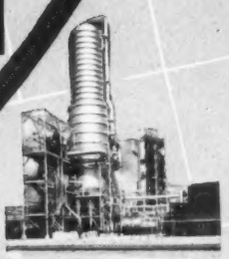
Offices in Principal Cities

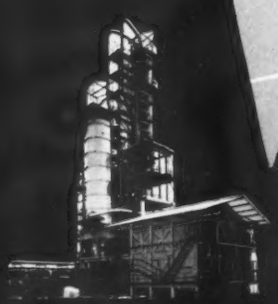
crude distillation units

70,000 B/D



63,000 B/D

40,000 B/D



18,000 B/D

in any capacity

At the service of refiners:—Foster Wheeler's extensive know-how is available for the design and construction of all types of crude distillation units—both large and small.

A detailed description of a recently completed 63,000 barrel per day crude unit was presented in the April issue of Heat Engineering. Copies are available on request. Write for HE-4-51 to:

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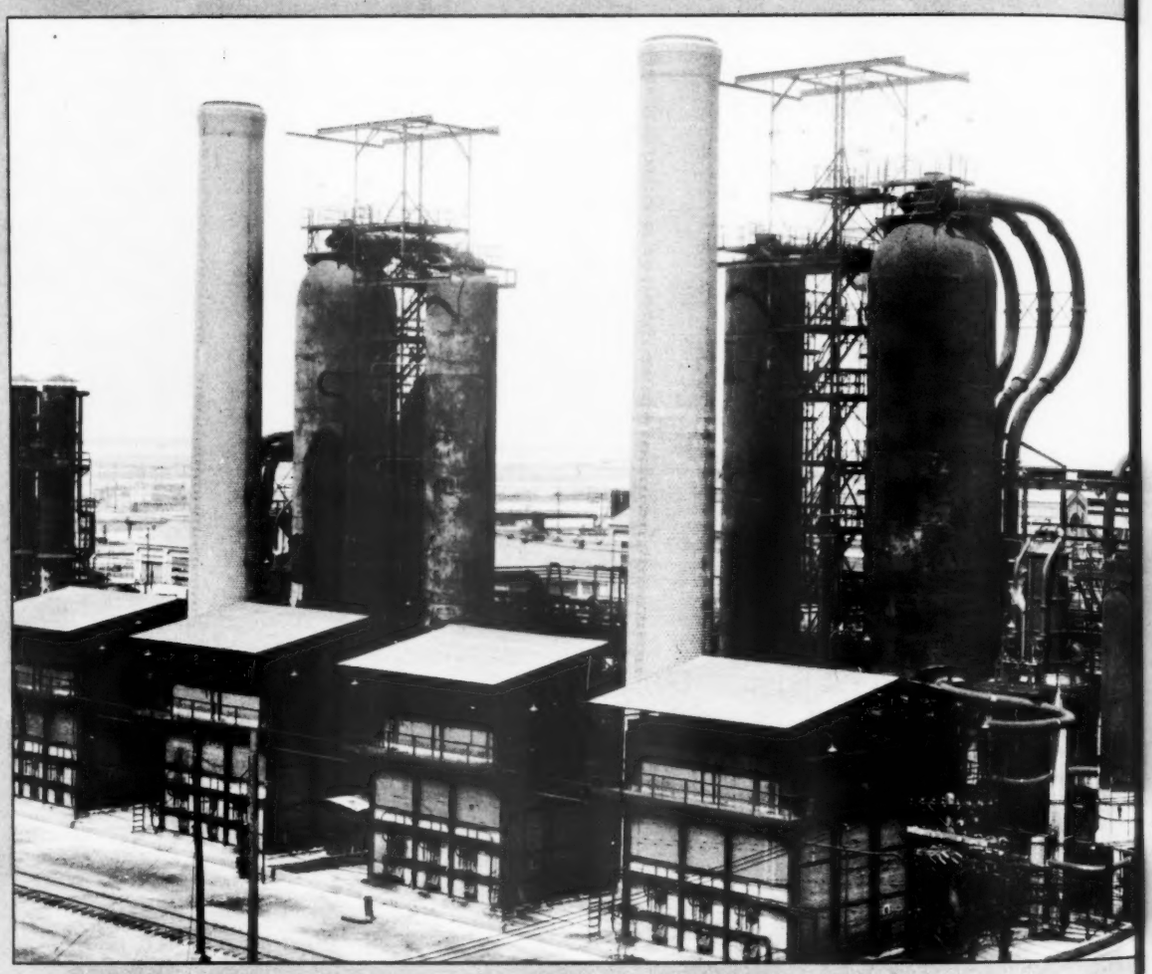
more than **500** process units designed and constructed by Foster Wheeler

when you're leaving the refinery..



...it's a comforting feeling to know that those process units out there were designed 'right'... were built 'right'... and have a record of proven dependability.

The two two-stage crude distillation units in the photograph were designed and constructed by Foster Wheeler in 1931 *and they're still running... every day.*

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PETROLEUM CHEMICALS DIVISION
NEWS

June ★ One of a Series of Interest to the Petroleum Industry ★ 1951

DU PONT COMPLETES NEW PETROLEUM LABORATORY FACILITIES

J. J. Mikita Appointed Director of Du Pont Petroleum Laboratory

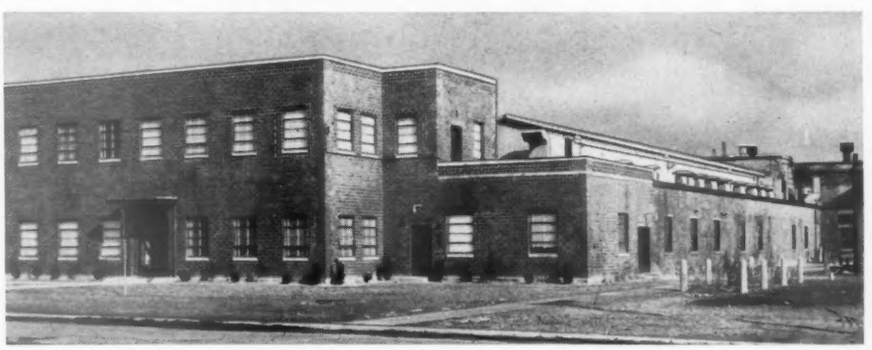
February 1, 1951 marked the beginning of J. J. Mikita's second term as director of the Du Pont Petroleum Laboratory. He previously held the post from September 1946, when he first joined the Company, until October 1949.

Since then he has served as assistant technical manager at the Wilmington Office. His return to the laboratory was prompted by the expanding activity of petroleum chemicals research being carried on at the new quarters.

Mr. Mikita was graduated from Penn State College and received his Masters Degree in mechanical engineering there in 1933. He continued at Penn State as a research assistant until 1936, when he joined the Texas Company as an engineer. There he became associate director of research before joining Du Pont in 1946.

Buildings House Main Research Activity of Expanding Du Pont Petroleum Laboratory

To accommodate the rapid expansion of Du Pont's petroleum research work, major additions to the Petroleum Laboratory set-up have recently been completed at the Chambers Works in Deepwater, N. J. These additions consist of several structures, designed especially for petroleum research.



Main laboratory building has a monitor top which houses fuel, air, water and electric lines. Administrative offices, conference and reception rooms are located in two-story front section. Remainder of building is devoted to engine testing compartments and general service equipment.

In addition to the main building, which houses the offices and test engine rooms, there is a complete fuel blending unit and tank farm. Also an enlarged garage with maintenance facilities for the road-test fleet. Construction was started in August 1949 and today all units are equipped to operate at full capacity.

Activity ranges all the way from basic research on combustion problems to development of additives for jet fuels. It includes the design and construction of special test engines and instrumentation on road-test automobiles.

FUNCTIONAL DESIGN

The main building was developed with an eye to comfort and efficiency as well as to the safe handling of fuels and exhaust gases. Twenty-six stands for mounting test engines are distributed through eight rooms. On them, engines ranging from small single-cylinder test engines to the largest truck diesels can be operated.

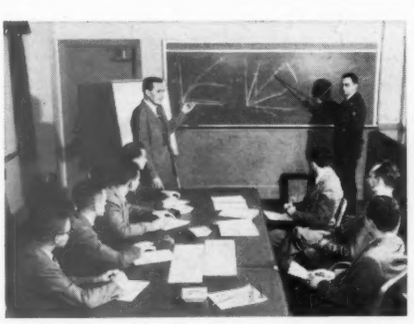
Many of the stands are equipped with dynamometers for absorbing and measuring engine power. They carry extensive instrumentation. For added safety and comfort, the operating controls and instruments are mounted on panel boards at a distance from the engines – frequently outside the engine room.

In addition to complete engine testing facilities, the main building contains air-conditioned offices and con-

CONTINUED ON PAGE 3

Laboratory Conferences Coordinate Research

Close cooperation by the laboratory staff is an important factor in Du Pont petroleum research. Here Mr. Mikita is discussing test results with the engineering group. Meetings like this speed up laboratory operations as well as plans development. They also give each engineer an opportunity to contribute to the various projects.



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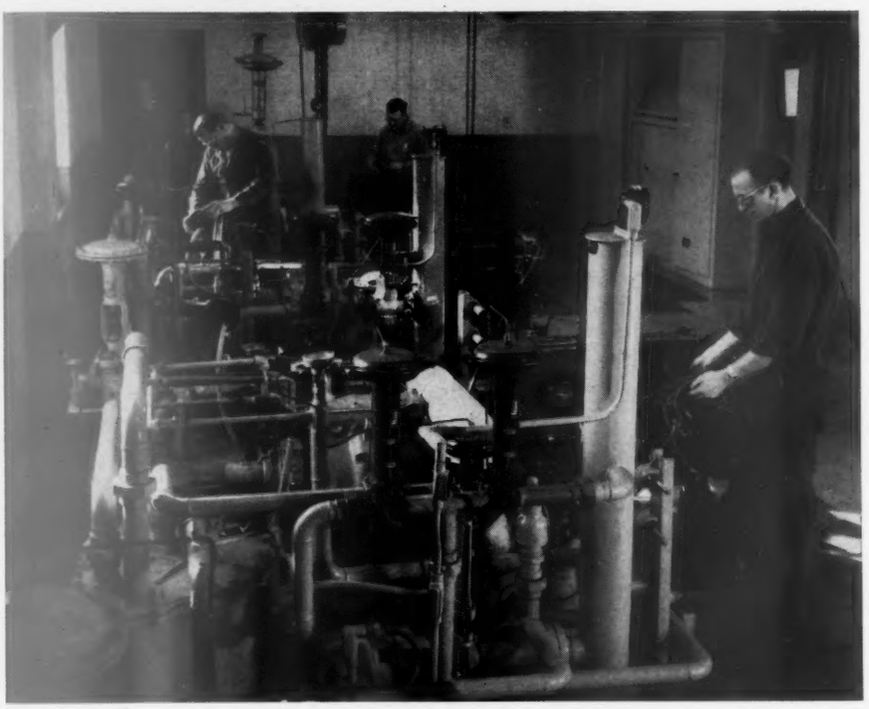
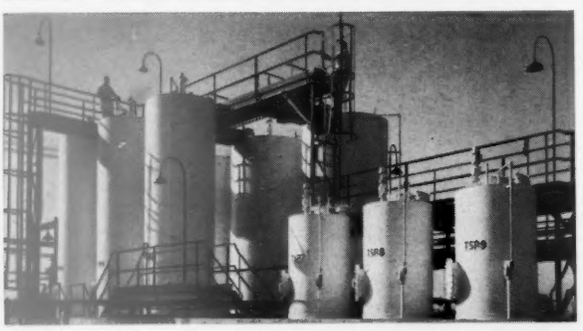
PETROLEUM CHEMICALS DIVISION NEWS



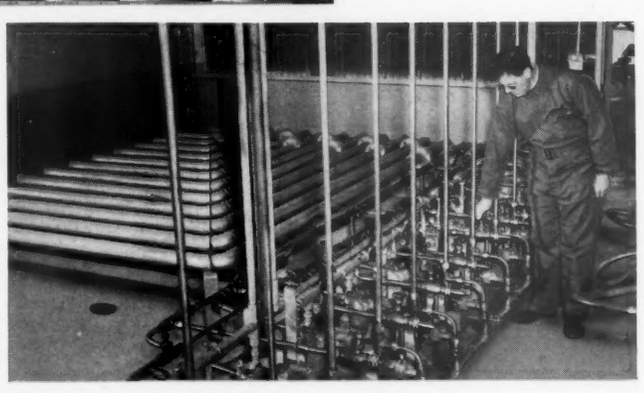
Today's Engines Help Develop Tomorrow's Fuels

Stock engines representing standard car makes are used for research on fuel performance at the Du Pont Petroleum Laboratory. Mounted on stands in this multi-cylinder engine testing room, they are connected with dynamometers and other testing devices. Special instrumentation—on panels outside the room—records the performance of each engine. The results of these tests are the bases for findings that lead to improved fuels and lubricants and better engine performance. There are two multi-cylinder engine rooms in the new laboratory—additional rooms in the old buildings.

Complete Storage and Blending Facilities



THE NEW TANK FARM has a storage capacity of more than 60,000 gallons. Each of its 12 tanks can be used for storing a different fuel. Located a safe distance from the main building, the farm is connected to the fuel transfer and blending building by a system of pipelines which permits complete blending flexibility.



THIS ORDERLY ARRANGEMENT of pipelines and blending pumps in the transfer and blending building simplifies blending operations. To assure safety and accuracy, each pipe is clearly identified.

Safety and Comfort Featured in New Du Pont Laboratory Buildings

Fuel lines . . . exhaust gases . . . electric wiring . . . high pressure air lines! Put them all together, and they can spell trouble—unless careful handling keeps them functioning safely. Special attention was paid to the design of the laboratory buildings so as to virtually eliminate danger and trouble from any of these sources.

To isolate these services, an enclosed area running the length of the laboratory was built on the roof. Fuels and electrical services are routed to the engine room through concealed ducts. Engine exhaust, coolant and spilled liquids are collected in a sealed trench which passes under the floor. Special pumping equipment keeps them moving out to safe disposal facilities. A complete change of air in each engine room is provided every 3 to 5 minutes.

Built-in ventilation control and fire protection, important features of the laboratory design, are frequently checked to assure safe operation.

Many control panels are located in this corridor—outside of the engine rooms. Test stands are equipped with an automatic device to stop the engine if unsafe conditions develop.

As a double check, a warning is flashed by this clearly visible panel should anything go wrong with the ventilating system or other protective equipment.

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DU PONT
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PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT
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An Engine Writes Its Own Story!

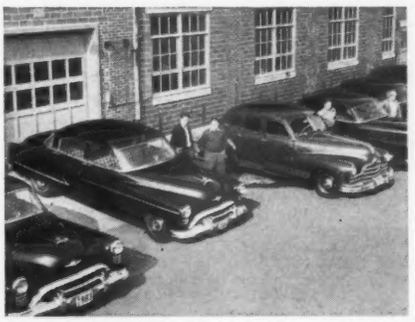
On this control panel are dials and instruments to register all significant details of an engine's performance. Variations in the performance of fuels can be accurately charted. The engine itself can be observed by the operator through the recessed window in the center of the panel.

An indicator chart tells this laboratory technician the pressure being generated in the combustion chamber of a single-cylinder engine. Through recording instruments, the engine actually writes its own story.

Du Pont Designs and Builds Special Instruments for Petroleum Research

ELECTRONIC INSTRUMENTS for engine testing are developed and assembled in this laboratory workshop. This work includes some of the special instrumentation and apparatus built into the test fleet cars, as well as the intricate control panels for laboratory test engines. The Petroleum Laboratory also has its own machine shop and engine overhaul room.

BASE OF OPERATIONS FOR DU PONT TEST FLEET



This brick structure, near the new laboratory building, is the garage headquarters for the Du Pont east coast passenger car test fleet. Many standard makes are represented in the 28-car fleet. Equipped with special instrumentation, the cars are essentially on-the-road research laboratories.

Complete servicing and overhaul facilities are installed in the garage. Special equipment keeps testing devices of the cars tuned to a high degree of accuracy.

CONTINUED

New Lab Facilities

ference rooms for laboratory personnel. It also houses the many auxiliary services needed for operating the laboratory . . . plus a lunchroom for those who do not make use of the plant cafeterias.

COMPLETE SERVICE FACILITIES

To keep research work progressing satisfactorily many extra services are needed. For convenience and efficiency, provisions for these are built into the main laboratory wherever possible. There is an overhaul shop for rebuilding engines and a machine tool room for turning out special engine parts. For routing 18 fuels from the blending building to any of the 26 test engines there is a special piping system which supplies the necessary flexibility for experimental work.

From the compressor room comes dry and oil-free air for supercharged engines, as well as air and vacuum service for various instruments. The laboratory has its own electronic shop where new instruments are developed and repairs are made.

OVER

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PETROLEUM CHEMICALS DIVISION
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CONTINUED *New Lab Facilities*

SIMULATES REFINERY

The blending building and tank farm are similar to those found in refineries. Twelve storage tanks give the tank farm a capacity of more than 60,000 gallons. Racks provide additional storage for 360 fifty-five gallon drums.

In the blender building, tetraethyl lead and other additives can be readily blended with any combination of fuels from the main tanks. These fuels can be dispensed directly to test-car refueling pumps or to the laboratory fuel distribution room.

WORK IN PROGRESS

An enlarged research program is already under way in the new facilities. It includes work on fuel storage stabilizers and additives for making lube oils more suitable for modern high-speed engines. Studies of basic combustion problems have been expanded and are aimed at discovering new methods of suppressing knock.

PIONEER

Dr. W. S. Calcott Directed Early Research on TEL

In 1922 the Du Pont Company accepted a challenge to manufacture tetraethyl lead safely. The intensive study and exhaustive experimental work that followed was under the able leadership of Dr. W. S. Calcott of the Du Pont Jackson Laboratory.

As a result of this work, Du Pont was successful in perfecting a process for producing tetraethyl lead which contributed important features toward maintaining the excellent safety record subsequently established in the manufacture of this product. The basic techniques developed by Dr. Calcott and his associates are still in use today.

Continuous Tests Show Way to Product Improvements

Tested in use, in storage, in idling engines, and in combination with other fuels or lubricants—every Du Pont additive must pass a comprehensive schedule of tests before it is made available to the industry.

Constant evaluation of product characteristics sometimes leads the way to the development of new and better products—another important contribution of Du Pont research.

Exploring basic combustion chamber reactions is a continuing job at the Petroleum Laboratory. It is helping to pave the way for future improvements in fuel antiknock additives. Problems are first studied in the laboratory and then taken out on the road where they can be studied under varying driving conditions. Seven of the laboratory's 28 cars are specially equipped to do this work.

Chemical analysis of fuel components and reactions is among the steps constantly employed in the development of petroleum additives.

In connection with gasoline, Du Pont research contributed to an effective metal deactivator as well as several antioxidants for increasing stability.

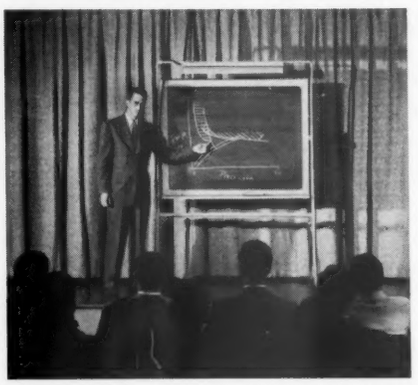
How Du Pont Research Aids Petroleum Refiners

To help refiners in the economical and efficient use of current additives is one of the primary aims of Du Pont petroleum chemicals research. Another is the development of new fuels and lubricants. To accomplish these things, the program is unusually broad.

It includes the work of test fleets—both passenger cars and heavy-duty trucks—as well as laboratory studies.

For on-the-spot assistance, five conveniently located field laboratories are prepared to conduct special investigations on your own fuels, as well as help with treating and blending problems.

In addition, many of the findings of Du Pont's vast company-wide research program have valuable application in the petroleum industry. Neoprene, explosives and finishes are outstanding examples.



Refinery research groups find it helpful to attack their problems in joint meetings with Du Pont petroleum specialists.

LITERATURE AVAILABLE

The following is a partial listing of free Du Pont bulletins, reports, booklets and aids available to you. Address request to your nearest Du Pont Petroleum Chemicals Division District Office.

Working with the Petroleum Industry —information about Du Pont's TEL manufacturing and research facilities . . . . . Serial A-8620

Tank Talk—a 52-page, pocket-sized booklet written for the men who actually enter and clean gasoline storage tanks . . . . . Serial A-1134

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Better Things for Better Living
. . . *through Chemistry*

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District Laboratories: Wilmington, Del. · Chicago, Ill. · Tulsa, Okla. · Houston, Texas · El Monte, Calif.

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BURNERS

Can't be beat for Gasoline Plant Boilers!

SERIES VBM

GAS & COMBINATION GAS & OIL BURNER

They permit the release of more units per cubic foot of furnace volume.

They are the first really satisfactory combination gas and oil burners for vertical firing.

They permit perfectly even distribution of heat in the furnace.

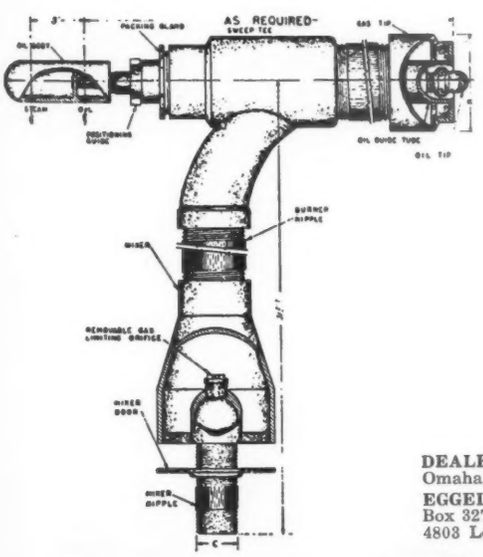
Any gaseous fuel at pressures in excess of five pounds may be burned perfectly satisfactory.

Any commercial fuel oil may be burned when properly prepared.

Extreme simplicity of design and ease of control prevent operational difficulty.

High sulphur content gases may be burned without port stoppage.

They give maximum duty with a minimum of furnace draft.



SERIES "ST"

AUXILIARY GAS BURNER

Foolproof, Windproof, Rainproof and Blowout proof.

Operates on all pressures—Few ounces to 50 lbs. Sharp stiff cylindrical flames at low excess air. 100% primary air with 8-1 turn-down range. Ideal Blowout proof pilot for larger burners.

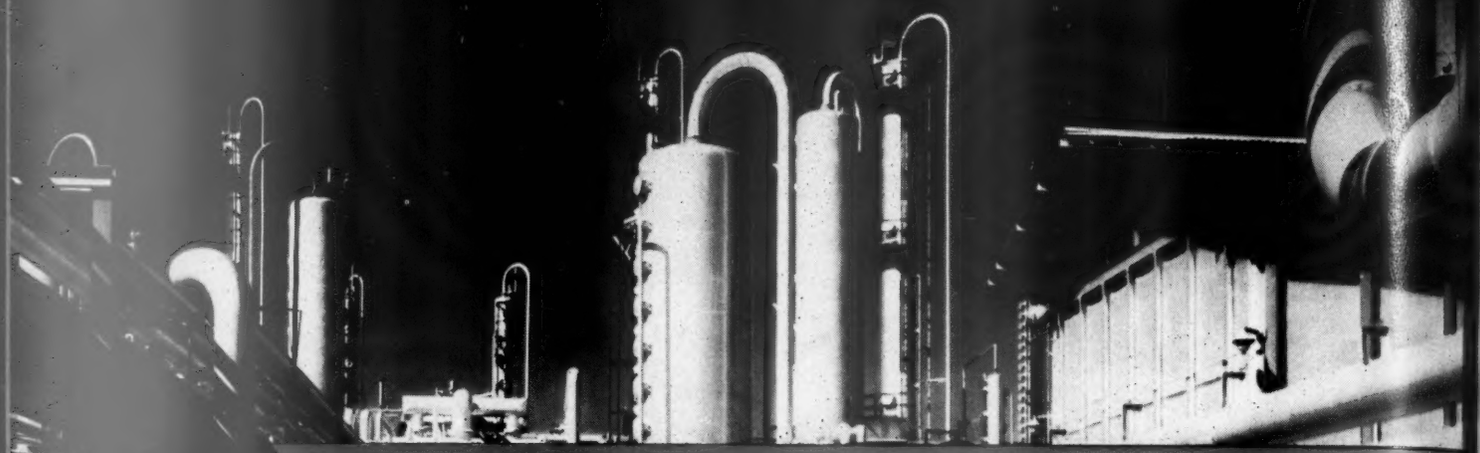
DEALERS: J. ARTHUR MOORE, 342 Madison Avenue, New York; S. L. O'NEILL, Omaha, Nebraska.

EGGELHOF ENGINEERS: HOUSTON, P. O. Box 1743; CORPUS CHRISTI, P. O. Box 3276; SAN ANTONIO, 1013 Avenue B; LUBBOCK, P. O. Box 1174; DALLAS, 4803 Lemmon Avenue; NEW ORLEANS, P. O. 9097; SHREVEPORT, P. O. 1055.

JOHN ZINK COMPANY

4401 South Peoria — Tulsa, Oklahoma

Name the toughest valve job in your plant



Is it CHLORINE? HYDROFLUORIC ACID? CAUSTIC? AVIATION GASOLINE? LPG? SULFURIC ACID? AMMONIA? ETHYLENE OXIDE?

THE Cameron NON-LUBRICATED LIFT-PLUG VALVE

IS SPECIFICALLY DESIGNED FOR THESE AND OTHER DIFFICULT SERVICES

Test this great new valve in your most difficult service. See for yourself how easily it operates and how tightly it seals, yet it requires no lubrication. No periodic maintenance. No danger of product contamination or clogging of metering equipment. No lubrication expense. It combines the best features of gate and plug valves with new Cameron innovations:

1. NON-LUBRICATED — no grease of any kind required to effect a seal; prevents contamination of line products; reduces chance for human error and expense of lubricant maintenance.
2. PRESSURE SEALING — when plug is seated, line pressure automatically forces seat into tighter engagement with plug — body distortions do not affect the seal.
3. UNIQUE LIFT-PLUG ACTUATOR — a novel mechanical design which lifts, turns and reseats plug in continuous turn of a lever.
4. RENEWABLE SEAT AND PLUG — easily replaced; permits any desired trim for specific services.
5. REPAIRS ON THE JOB — can be completely overhauled without removal from line; no special tools or skill required.
6. EASY OPERATION — requires less operating effort than other valve designs.
7. FORGED STEEL — all parts, including body for most sizes, are press or drop forged from specification materials.

Your inquiries are invited. Complete details will be gladly sent on request.

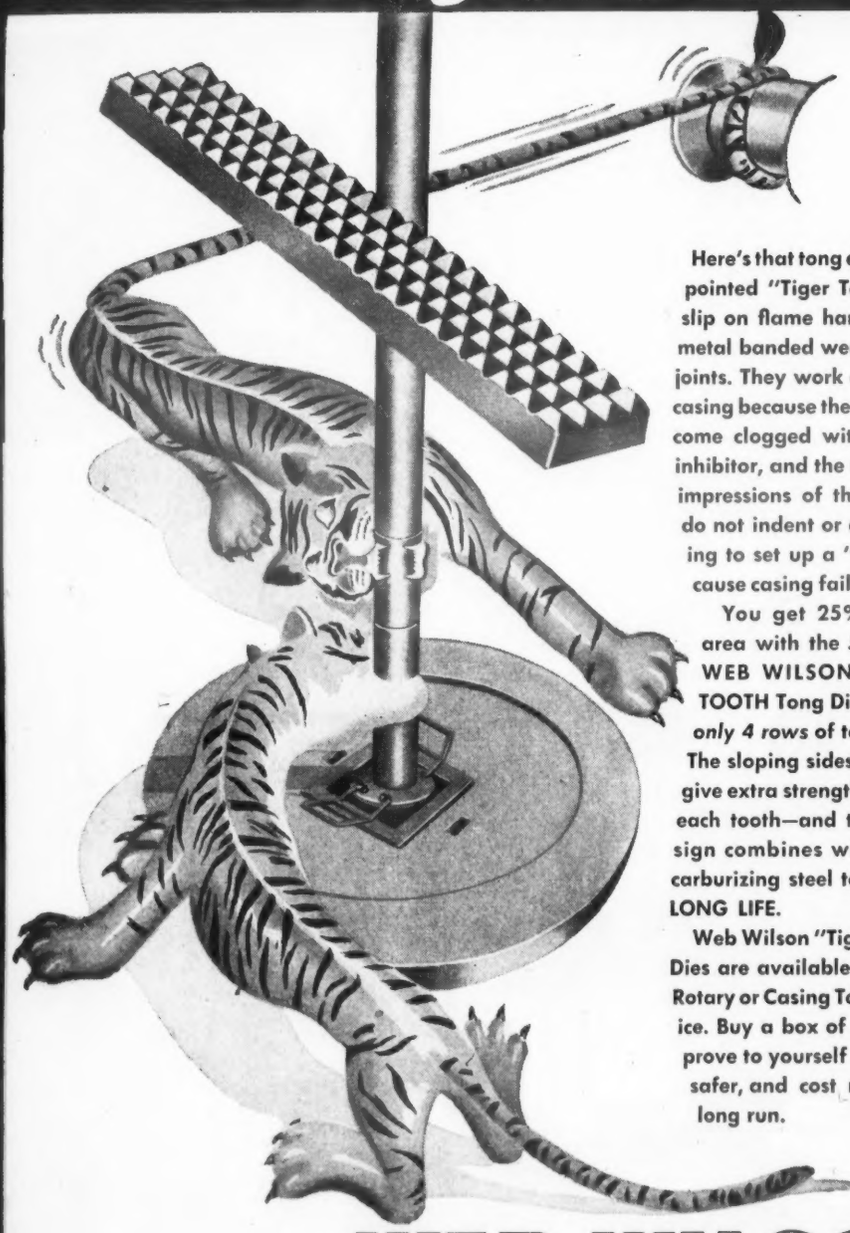
1 LIFT-PLUG ACTUATOR lifts, turns and reseats plug in only three-quarters of a turn of the operating wrench.

2 SEPARATE, RENEWABLE SEAT: Pressure-created body deflections and line strains cannot destroy the geometry of the fit between sealing surfaces because they cannot be transmitted to the separate seat.

Cameron
IRON WORKS, INC.
P. O. BOX 1212 HOUSTON, TEXAS
EXPORT: 74 TRINITY PLACE, NEW YORK, N. Y.

"WILEY" WEB WILSON Tiger Tooth TONG DIES

WEB WILSON *Tiger Tooth* TONG DIES



Here's that tong die with the sharp, pointed "Tiger Teeth" that won't slip on flame hardened, or hard-metal banded wear subs and tool joints. They work equally well on casing because the teeth do not become clogged with scale or rust inhibitor, and the slight, pin-point impressions of the pointed teeth do not indent or damage the casing to set up a "stress riser" and cause casing failure.

You get 25% more gripping area with the *5 rows of teeth* in WEB WILSON 1¼-inch TIGER TOOTH Tong Dies, compared with *only 4 rows* of teeth in other dies. The sloping sides and heavy base give extra strength and backing to each tooth—and this efficient design combines with high grade carburizing steel to insure EXTRA LONG LIFE.

Web Wilson "Tiger Tooth" Tong Dies are available for use in *any* Rotary or Casing Tong now in service. Buy a box of one dozen, and prove to yourself that they are far safer, and cost much less in the long run.

I'M "JIFFY" THE TONG DIE DRIVER

I drive 'em, in and I drive 'em out! And the men who "knock" me most are my best friends. I put up a hard front to give years of service—But I'm softer in the rear end so you can hammer away without having any chips popping off to hit you in the eye—And my overhanging upper lip keeps any pieces of the die from flying around.

TONG MEN, listen a minute . . . Haven't you had enough of trying to drive tong dies in or out with a bolt or a cold chisel, or whatever was handy? Want to stop mashing fingers, and get away from those flying chips off hardened tong dies that can put out an eye or cut your hands or face like a razor? ★ Here's how we'll do it . . . I'm "Jiffy" and I came into this world for just one reason—to work with men like you to save you a lot of grief. You'll go for me on sight, and if your tong dies are 1 inch wide I'll work for years and years for only $7.50. If you are using 1¼ inch dies, make it $10.00. ★ You won't have any trouble getting the boss to buy me when he sees how I save time and money and accidents. In fact, he'll probably get "Jiffy" Twins just in case one of us gets misplaced somewhere. Ask him the next time he's on the rig—the name is "Jiffy."

P-S-S-T . . . let me whisper to you Safety Engineers. ★ If you really knew how I cut accident rates you would personally introduce me to *every* crew on *every* rig under your eagle eye. Crews *gladly* stop using bolts, cold chisels (or what have you?) when "Jiffy" comes on the job to install and remove tong dies. I keep chips or pieces from flying off hardened tong dies to injure eyes, hands or face, and I save a lot of mashed fingers. ★ Any Web Wilson man has "Jiffy" Tong Die Drivers in his car for immediate delivery—ask him!

WEB WILSON Oil Tools INC.

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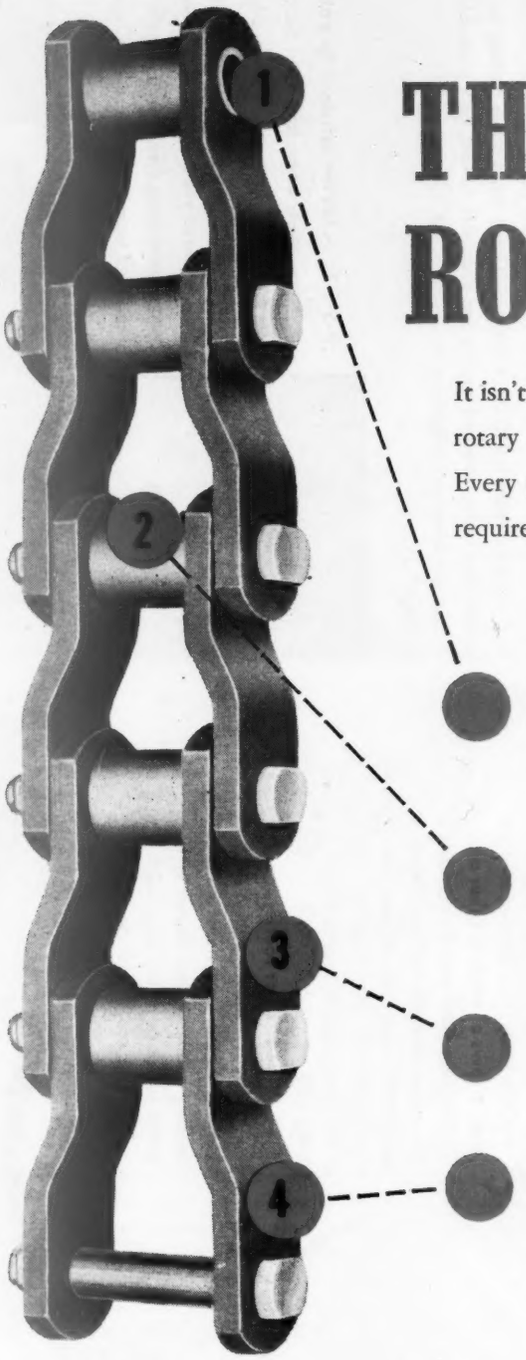
Link-Belt SS-40 Hyper

THE LONG LIFE ROTARY CHAIN

It isn't chance that delivers the kind of chain you need for high rotary speeds—it's advanced engineering and manufacture. Every piece of Link-Belt A. P. I. Chain is built to meet these requirements.



SS-40 Hyper
A. P. I. 3.

BUSHINGS Machined alloy steel—case hardened for greatest wear resistance—ground internally and externally to precision accuracy.

ROLLERS Alloy steel—heat treated for maximum wear resistance; shot peened for greater fatigue life; close tolerances for smooth, easy movement.

PINS Forged alloy steel, precision ground, cadmium plated.

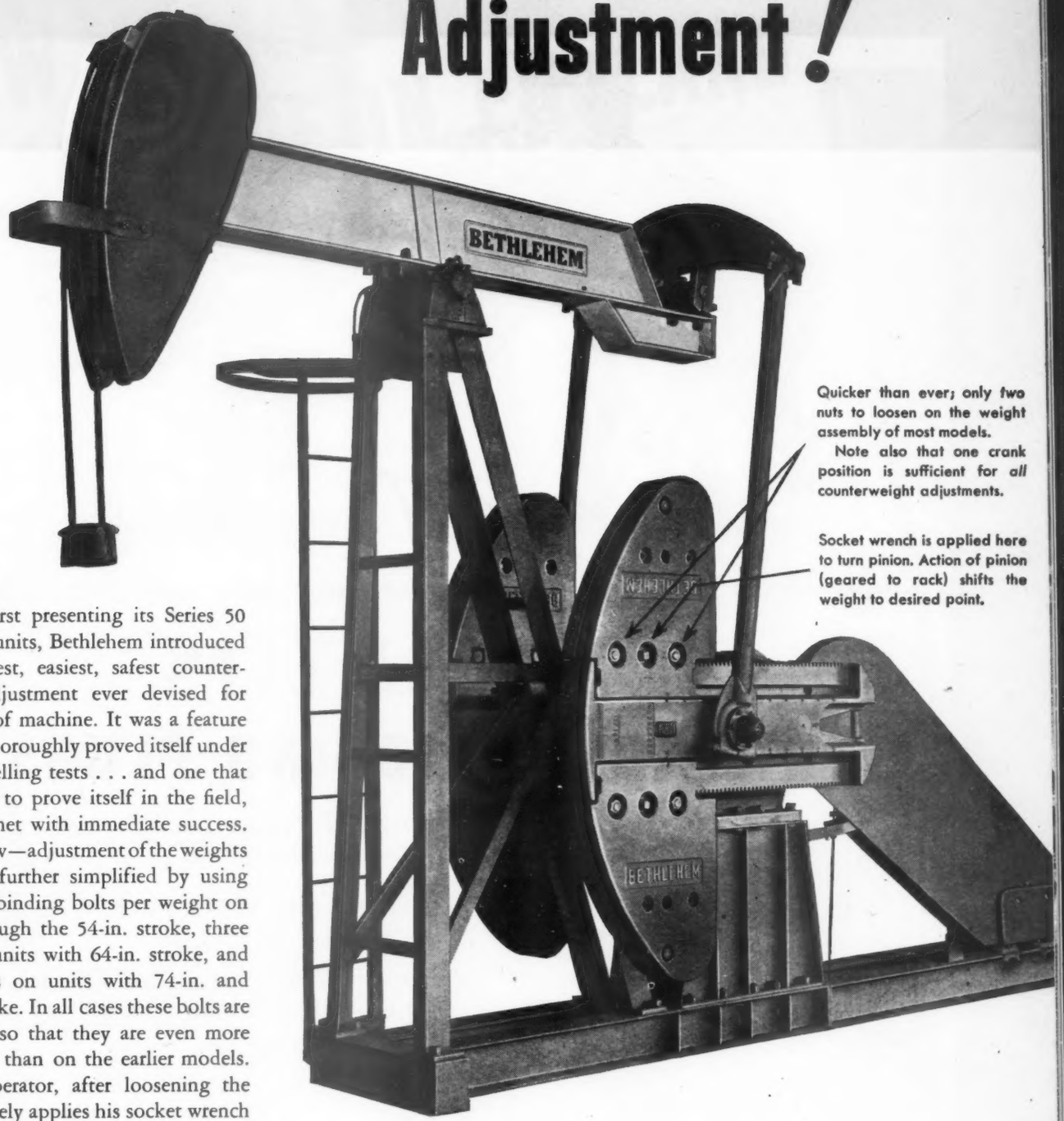
SIDE BARS Selected alloy steel—heat treated. Pitch holes finished to precision limits with size and pitch accurately controlled.

LINK-BELT COMPANY
Indianapolis 6, Dallas 1, Houston 1, Los Angeles 33, New York 7. Distributors in all fields.
12,431

LINK-BELT

CHAINS and SPROCKETS

Now...Even Simpler Counterweight Adjustment!



Quicker than ever; only *two* nuts to loosen on the weight assembly of most models.

Note also that one crank position is sufficient for *all* counterweight adjustments.

Socket wrench is applied here to turn pinion. Action of pinion (geared to rack) shifts the weight to desired point.

When first presenting its Series 50 pumping units, Bethlehem introduced the simplest, easiest, safest counterweight adjustment ever devised for this type of machine. It was a feature that had thoroughly proved itself under many gruelling tests . . . and one that continued to prove itself in the field, where it met with immediate success.

And now—adjustment of the weights has been further simplified by using only two binding bolts per weight on units through the 54-in. stroke, three bolts on units with 64-in. stroke, and four bolts on units with 74-in. and 86-in. stroke. In all cases these bolts are "in line" so that they are even more accessible than on the earlier models.

The operator, after loosening the bolts, merely applies his socket wrench to the end of a pinion shaft. He moves the wrench gently, with little or no effort, and the weight shifts position. Numbered graduations on the crank, and an index on each outer counterweight shell, facilitate adjustment.

It's all so effortless and safe! No climbing or scrambling. The operator stays on the ground, and there's nothing that can fall from the unit and hurt him.

For more details, call Bethlehem Supply—the office or store nearest you. Information will be furnished promptly.

BETHLEHEM SUPPLY COMPANY

General Offices: 21 E. Second St., Tulsa, Okla.
West Coast Headquarters: Los Angeles, Calif.
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

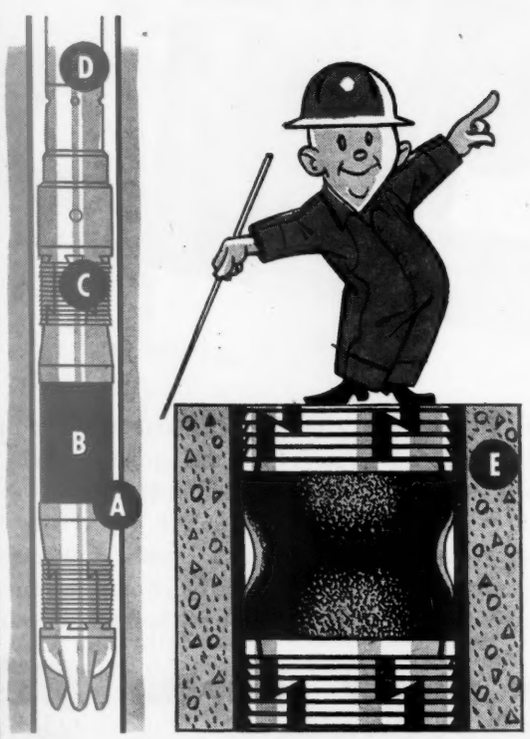
You can read all about 'em—if you want to

now—let's just look at a few reasons why operators like

LANE WELLS

TECHNICAL OILFIELD SERVICES

DRILLABLE BRIDGING PLUGS



A Notice the greater clearance — this means faster running in fluid.

B Longer sealing element — for leakproof pack-off.

C These BIG interlocking slips hold fast on any casing without casing damage.

D This removable ram-adapter cuts down knock-out time. With either rotary or cable tools, you can drill out or knock down a Lane-Wells Bridging Plug in 4 to 6 hours.

E Positive pack-off right where you want it, as long as you want it — resists pressure from above or below. Under normal conditions, Lane-Wells Drillable Bridging Plugs have successfully withstood differential pressures as high as 10,000 p.s.i.

Tomorrow's Tools—Today!

Ask Your Lane-Wells Man!

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NOW . . . McEVOY VALVES ALSO MADE IN ENGLAND

McEvoy Company has licensed Newman, Hender & Co., Ltd., well known British manufacturers, to produce McEvoy valves for sterling bloc distribution

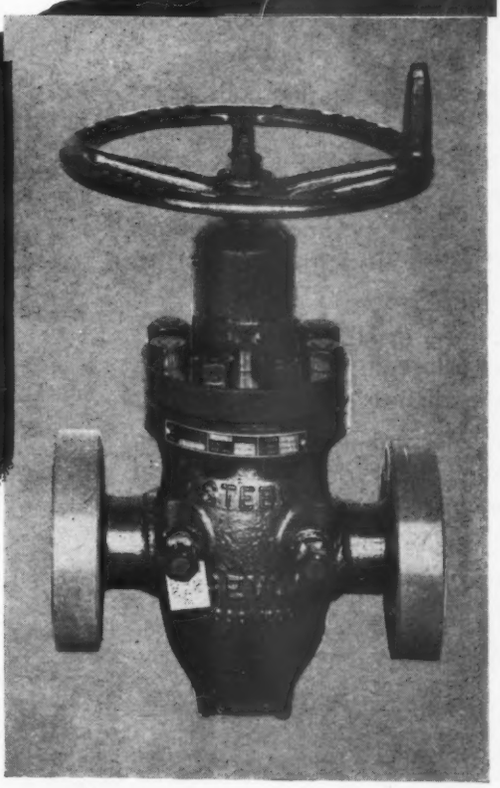
After testing all types of high pressure valves for the oil production industry, Newman, Hender & Co., Ltd., recently applied to the McEvoy Company of Houston, Texas, for rights to produce the McEvoy Gate Valve in England for sterling bloc distribution. This includes all parts of the world, excepting the United States and Canada.

Permission has been granted and, effective immediately, Newman, Hender will manufacture the complete line of McEvoy Gate Valves in their English plant.

McEvoy valves manufactured by Newman, Hender & Co., Ltd., will be called "Newman-McEvoy" valves. Those made in Houston by McEvoy will continue to be designated by the familiar McEvoy name.

Otherwise, whether made in the U. S. A. or in Great Britain, these service-tested gate valves will be absolutely identical, with all parts interchangeable.

Oil producers, particularly in remote foreign areas, will benefit by the new trade agreement in vastly extended, world-wide distribution and greatly increased availability of McEvoy Gate Valves.



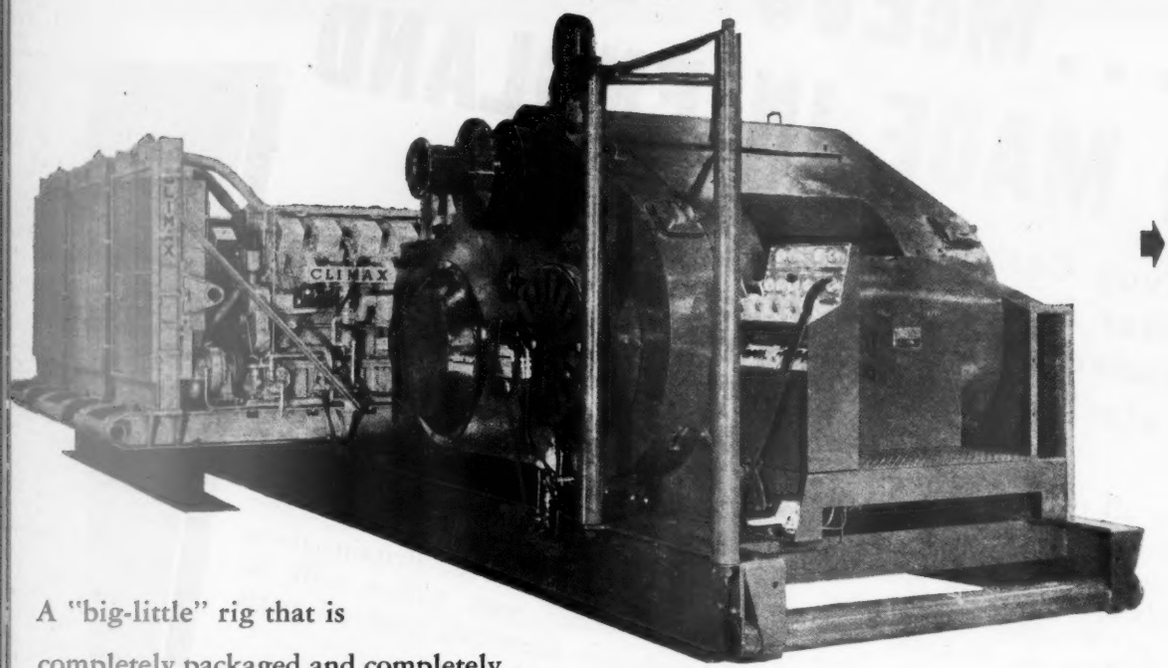
McEvoy and Newman-McEvoy Gate Valves are available everywhere in all sizes and all working pressures normally required in oil production. See Composite Catalog or write for illustrated Catalog 51.

McEvoy COMPANY

TEXAS AND MILBY ST. • P. O. BOX 3127 • HOUSTON 1, TEXAS

Export Representative: E. F. Gahan, Inc.,
Room 1223, 500 Fifth Avenue, New York, N. Y.

EMSCO *Announces...*



A "big-little" rig that is completely packaged and completely portable has been added to Emsco's famous line of "G" rigs. It's the new GB-800. It retains all of the field-proven features of the "G" rigs. In addition, it gives you these advantages:

- ***Greater operating economy.***
- Reduction in hole-to-hole downtime.
- Drawworks, engines and compounding transmission mounted on a common skid, or as a single-step, two-package unit.
- Simple, easy and fast means of removing and installing engines.
- Clean design that permits cradling of entire unit in the substructure.
- In line and individually-driven mud pump drives located at back of engine compound.
- Totally enclosed, positive pressure lubrication system.
- Drawworks friction clutches located on outboard ends of shafts.
- Console-mounted valve controls at driller's position.
- Large diameter drum.
- Two or three-engine compounding transmission.
- Optional built-in sand reel.
- Optional Emsco auxiliary brake package, dynomatic or hydromatic.

UNMATCHED PORTABILITY

Never has a rig of this horsepower been so completely portable . . . so quick and easy to rig up and tear down!

In the flat set, one-package rig, with drawworks, engines and compounding transmission mounted on a common skid, it is *never* necessary to break chains, oil lines or air lines. In the stair-stepped, two-package rig, only the in-put drive has to be disconnected in moving the rig.

The GB-800 is designed throughout to give you the most in portability and operating efficiency. For specifications and operating details call CONTINENTAL, or write for new Emsco "G" series rig bulletin.

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

EMSCO
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EMSCO DERRICK & EQUIPMENT COMPANY

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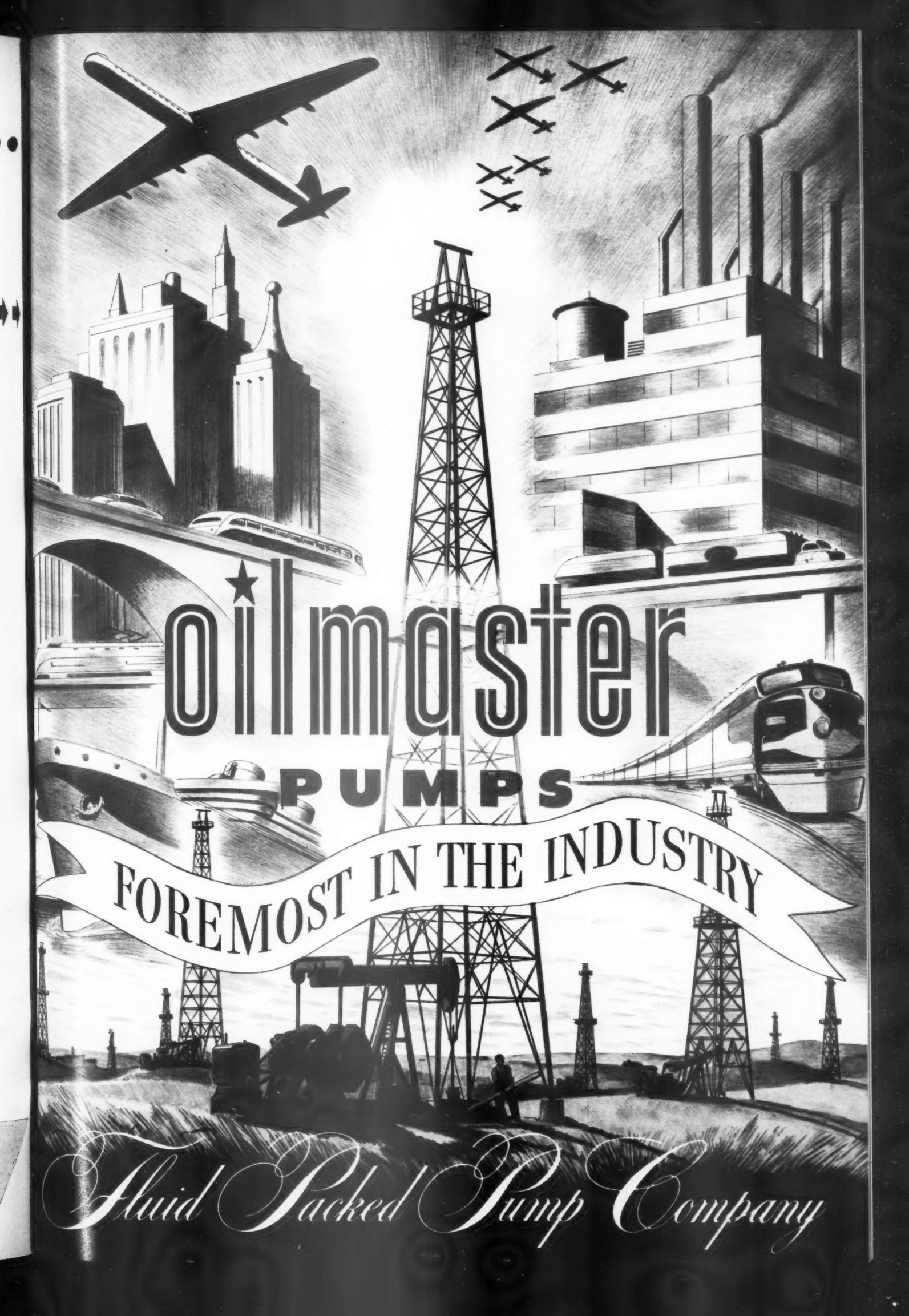
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PUMPS
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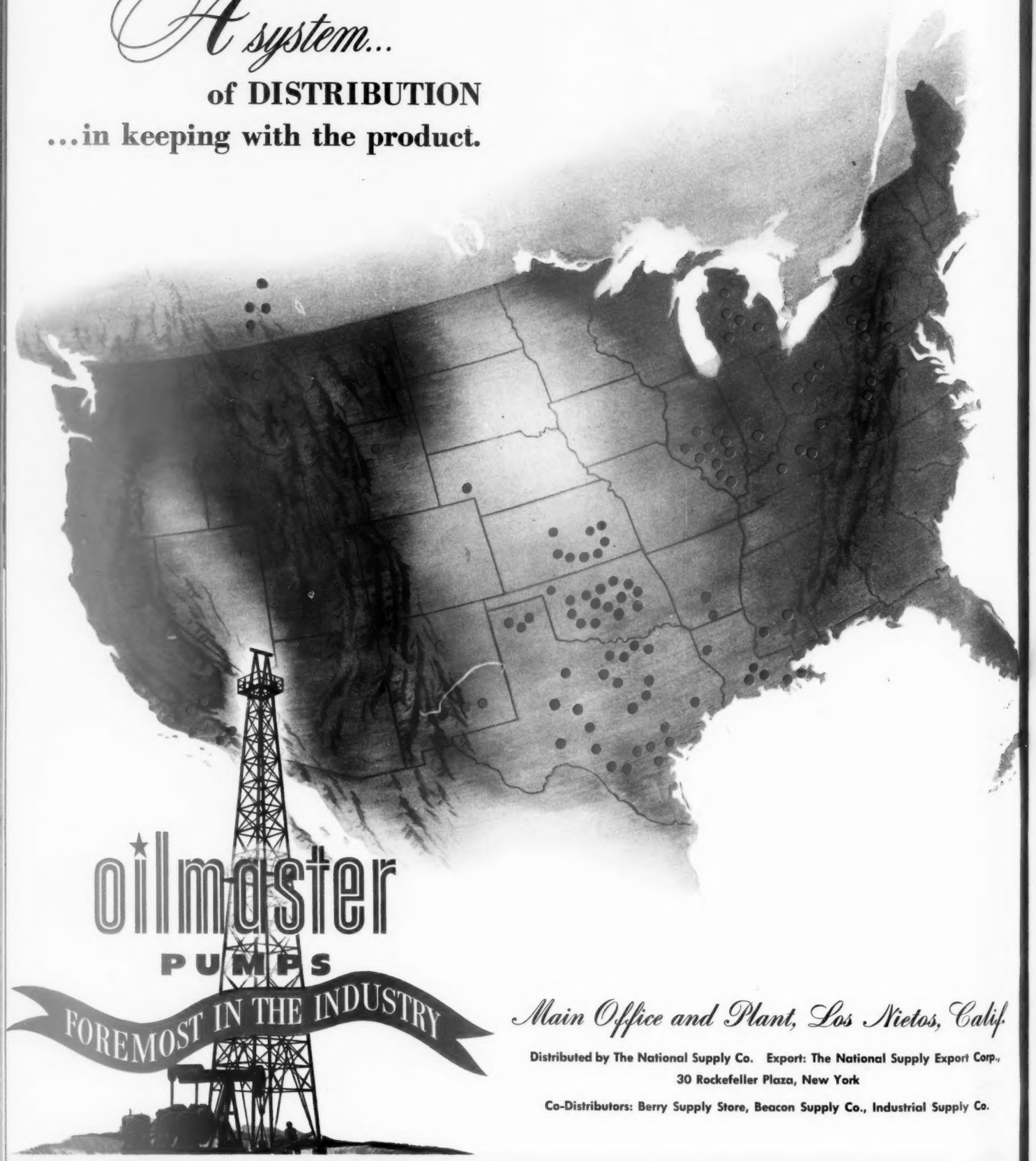
Fluid Packed Pump Company

A system...

of DISTRIBUTION

...in keeping with the product.



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Fluid Packed Pump Company

Stamina

for the steady grind

—and steady it is these days. Now as never before, working parts in drilling equipment *need* the strength and stamina of alloy steel.

Uniform response to heat treatment enables alloy steels to combine a high degree of core toughness and hard, wear-resisting surface. Thus, parts made of Republic Alloy Steels resist abrasion and wear. They withstand the stresses and strains of deep drilling. They *stand up* under severe service.

Why not let Republic's 3-Dimension Metallurgical Service help you insure against loss of time and revenue because of drilling break-downs. These field, mill and laboratory metallurgists will see that the *right* alloy steel analyses are applied to your specific needs.

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Other Republic Products include Casing—Tubing—Line Pipe—Upson Studs, Bolts, Nuts and Rivets—Electrunite Boiler Tubes

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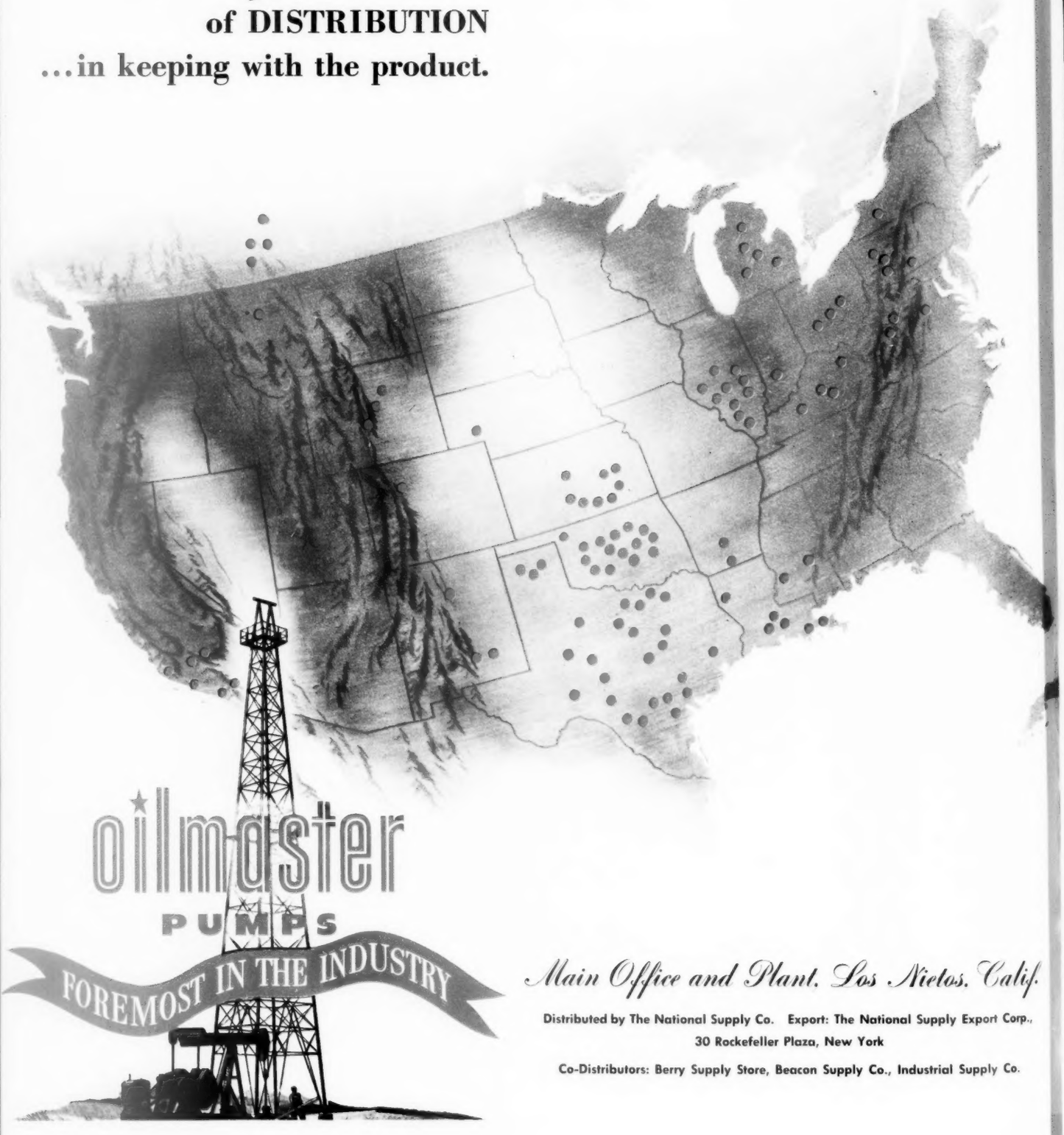

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REPUBLIC STEEL

Republic **ALLOY STEELS**

Other Republic Products include Casing—Tubing—Line Pipe—Upson Studs, Bolts, Nuts and Rivets—Electrunite Boiler Tubes

XUM

"You say I'll get more information with

LANE WELLS

Radioactivity WELL LOGGING"

OK - tell me why!

All right — here's why. There are four good reasons. First, there's *curve quality*. That means curves which faithfully record every formation change of any significance. Lane-Wells assures you these accurate, dependable curves through *advanced equipment* — instruments sensitive to every significant down-hole variation, instruments carefully calibrated to produce highly repeatable responses. Then, you have *accurate depth measurements*. You know the importance of those, and you know, too, that Lane-Wells measurement accuracy is tops in the field. And finally, you know the vital importance of *operating experience*. Lane-Wells has run more than 36,000 radioactivity well logs; Lane-Wells men know the problems of practically every active oil field. That experience can be a great help to you on your job, particularly in the matter of interpretation where local conditions produce unusual responses.

Add them all together — equipment, accuracy and experience — and what do you have? Better results with Lane-Wells Radioactivity Well Logging.

Tomorrow's Tools - Today!

ASK YOUR LANE-WELLS MAN!

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AR-406

Here's what WE mean by
DESIGNED FOR YOUR JOB

The new Allis-Chalmers tractors are not merely new models incorporating refinements of existing ideas . . . they are *new from the ground up* . . . without compromise anywhere in design or material.

They are the answer to your demands for tractors that will give you outstanding performance on a variety of applications — whatever those jobs may be.

Behind the design are your own ideas . . . and those of your operators and mechanics . . . combined with the vast experience of Allis-Chalmers. *Check the following outstanding features!*

POWER TO SPARE—A large untapped reserve (up to 1/3 of peak available hp.) assures easier going on toughest work — longer engine life, less servicing. Moreover, it has been proved that General Motors 2-Cycle Diesels are unmatched in lugging ability; they build up torque faster and higher . . . hold it longer.

MATCHED POWER TRAIN ASSEMBLIES — Each and every part of the power train — from master clutch to final drive — has more than enough capacity and strength to handle any load it was ever meant to carry. Bigger clutches, booster steering, double-reduction final drives, all add life — get more work done.

REVOLUTIONARY SHIFT PATTERN—A quick, one-lever shift from any forward speed to any reverse position saves shifting motion and time — smoother and easier, too.

POSITIVE BALANCE — Tractors work equally well with any equipment — drawn or mounted. There's *greater stability* and *traction* with more track on the ground and lower structural weight. Main and truck frames are heavier, truck frames longer . . . idlers are bigger, and both idlers and sprockets lowered . . . all steel construction throughout. Up to 50 percent more ground clearance!

ALLIS-CHALMERS
TRACTOR DIVISION — MILWAUKEE 1, U. S. A.

The Newest, Finest Tractor Line on Earth!

HD-5	HD-9	* HD-15	HD-20
40.26 drawbar hp.	70 drawbar hp.	102 drawbar hp.	Hydraulic Torque Converter Drive
11,250 lb.	18,800 lb.	27,850 lb.	175 net engine hp.
			41,000 lb.

- DESIGNED FOR YOUR JOB
- BUILT TO "TAKE IT"
- EASY TO OPERATE
- EASY TO SERVICE

XUM

TRET-O-LITE

TO HELP YOU PRODUCE PIPE-LINE OIL AT THE LOWEST POSSIBLE COST

1. A complete line of proved TRET-O-LITE dehydrating reagents, designed to correct your emulsion problems, economically.

2. The effective KONTOL Corrosion Inhibitors, in both liquid and stick form, designed to prevent the corrosion of sub-surface and other production equipment.

3. The TRET-O-LITE reagents designed to mitigate oil-in-water problems,—effective stream pollution preventives and sources of savings in salvaged oil.

4. The TRET-O-LITE Scale Preventives, especially developed to prevent production difficulties encountered when hard-water scales are a problem.

5. The SOLVO, PARASOL or PARID paraffin reagents, with solvent and detergent properties, are often economical answers to an annoying paraffin problem.

6. A large staff of trained treating service engineers, located in or near every oil field, always ready to advise and assist you with your production problems.

TRETOLITE COMPANY

Chemicals for the Petroleum Industry

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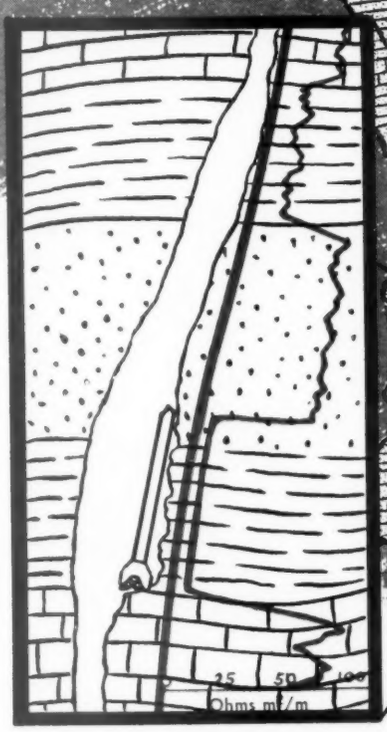
DEHYDRATING • DESALTING • CORROSION INHIBITION • SCALE PREVENTION • WATER DE-OILING • PARAFFIN REMOVAL

LOCATE "FISH" WITH THE SCHLUMBERGER ELECTRICAL LOG



MANY OPERATORS USE THE SCHLUMBERGER ELECTRICAL LOG AS AN AID IN DETERMINING THE DEPTH AT WHICH A "FISH" IS LODGED

Because the electrical resistivity of steel is many times less than that of the ground, anomalies on the electrical log caused by lost drill collars, joints of drill pipe, and parted casing are very definite. It is possible to save many hours on a fishing operation by appropriate use of the Schlumberger Electrical Log.

The next time you are faced with a fishing operation, call your Schlumberger Engineer.

SCHLUMBERGER

Schlumberger's progressive policy of research and engineering continues to provide advanced services to the oil industry.

SCHLUMBERGER WELL SURVEYING CORPORATION • HOUSTON

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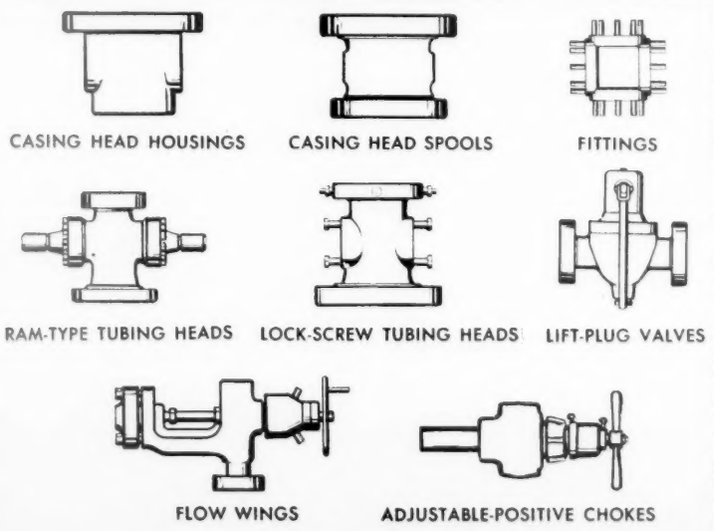
Cameron all forged steel SAFETY XMAS TREES

THESE CAMERON FORGED STEEL UNITS ARE AVAILABLE FOR ASSEMBLY IN ANY MAKE CHRISTMAS TREE



Here are three good reasons why more and more production men are switching to Cameron Forged Steel Christmas Trees exclusively: (1) ***A Superior Product:*** Every unit in the assembly is of close-grain, high tensile strength, forged steel . . . the only Christmas tree available in 100% forged steel. (2) ***Economy:*** The Cameron shops are tooled up for mass production . . . from steel billets to finished products . . . of a wide selection of well head equipment. This everything-under-one-roof plan results in manufacturing economies which are passed on to the customer. (3) ***Undivided Responsibility:*** Whereas the responsibility for proper operation and servicing is divided among several manufacturers whose products may be used in a Christmas tree assembly, Cameron assumes the full responsibility for the All-Cameron tree.

Complete details on all Cameron products are carried in your Composite Catalog, or literature will be gladly sent on request.

CAMERON IRON WORKS, INC.
P. O. BOX 1212 HOUSTON, TEXAS

EXPORT: 74 TRINITY PLACE, NEW YORK, N. Y.

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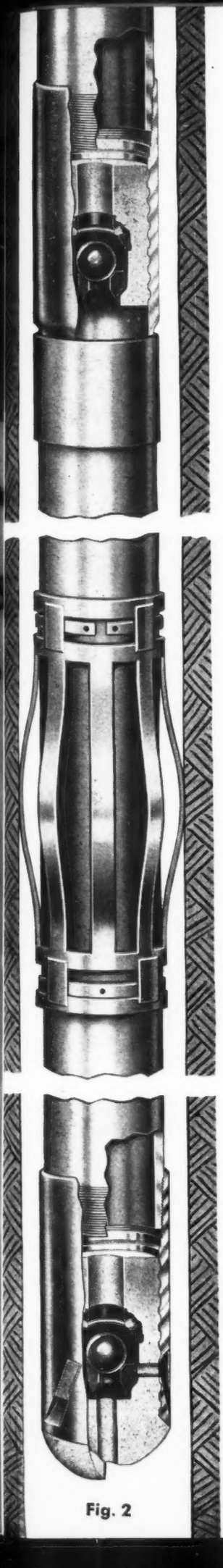


Fig. 2

EVERY cementing job should be performed with equipment which provides maximum FLOATING EFFICIENCY • LANDING EFFICIENCY • CEMENTING EFFICIENCY . . . with COMPLETE DRILLABILITY and PROVEN DEPENDABILITY

When you use Baker Cement Equipment you *know* that the buoyant ball will seal against the resilient rubber ring (backed by sturdy interior construction) to provide leak-proof strength for FLOATING those long, heavy strings of casing. You *know* you can raise and lower the string to insure PERFECT LANDING at the desired depth. You *know* you will secure maximum CEMENTING EFFICIENCY by the "whirling" cement slurry, combined with COMPLETE DRILLABILITY. You will enjoy that peace of mind which comes from using equipment of PROVEN DEPENDABILITY in thousands of jobs under every imaginable well condition.

RESULTS ARE WHAT REALLY COUNT

You are assured of RESULTS when you use Baker Hook-Ups like those pictured at left. For wells up to average depth, use a Baker Cement Wash-Down Whirler Guide Shoe (Product No. 121) with Baker Model "G" Casing Centralizers (Product No 910-G) spaced throughout the cementing area to provide *maximum centering force at the cementing point*. Then with a Baker Cement Float Collar (Product No. 101 M&F) positioned a joint or two above the shoe, you have the world's best "float valve" for safety, plus a "stop" for the cementing plug so that cement tailings are retained inside of the casing. See Figure 1.

For deeper wells, where maximum "floating" strength is a worthwhile precaution, a Baker Cement Wash-Down Whirler Float Shoe (Product No. 120) used on the bottom of the string (Figure 2) gives double safety at negligible cost.

YOU GET EFFICIENT RESULTS WHEN YOU COME TO "CEMENTING HEADQUARTERS"

Call the nearest Baker representative or office. Find out how dealing at Cementing Headquarters means SUPERIOR RESULTS FOR YOU!

BAKER OIL TOOLS, INC.
HOUSTON • LOS ANGELES • NEW YORK

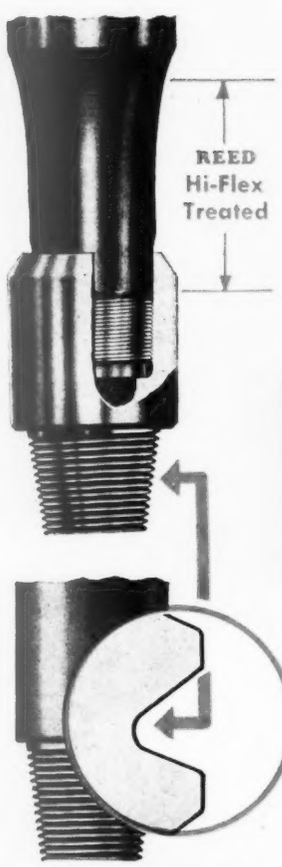
Only BAKER Cementing equipment provides whirling action

You get longer life and greater safety

with REED HiFLEX TREATED

Super Connection Drill Collars

The **REED** Hi-Flex treatment is a physical working of the surface of the steel so that the skin is placed under compression. It enables the steel to stand a much higher number of flexures without cracking, and it greatly increases fatigue life.



Hi-Flex Treated to Prevent Fatigue Cracks From Starting

CHECK THESE "LOWER-COST" ADVANTAGES

- **The Super Grip replaceable connectors are shrunk onto the drill collar.**
- **Hand applied (no bucking-on machine required).**
- **Can be applied to, or removed from, the drill collar at the drilling rig.**
- **No transportation cost to machine shop when joints wear past usable stage.**
- **No handling subs necessary.**
- **Same precision threads on pin and box at all times.**
- **No loss of length of drill collar when connectors are changed.**
- **No more "shopping" of your drill collar for re-threading — instead — the damaged or worn threads can be REPLACED by hand at the rig with factory-milled and factory-heat-treated threads.**

REED ROLLER BIT COMPANY

HOUSTON 1, TEXAS

NEW YORK LONDON BUENOS AIRES

THE MARK OF QUALITY

2810

Watching a man with an "M. D." degree

You can always depend on...

No university awards this "M. D." degree: the men of the oil country have given the title of "Mud Doctor" to the Baroid service engineer, because his tests and recommendations help to maintain fast, trouble-free drilling.

That "Mud Doctor" title is not just a flight of fancy. As drilling muds grow more and more complex, drillers and operators realize that drilling mud is a full-time proposition — a job for a specialist. So they call in the Baroid man to make tests, to recommend and to prescribe. His recommendations on mud are followed, probably more closely than you follow your own doctor's advice, because these experienced oil operators have found that it pays off in lower mud costs, faster drilling and safer operations. If you are not making use of the "Mud Doctor", why not call him now.

Baroid
BAROID SALES DIVISION
NATIONAL LEAD COMPANY
LOS ANGELES 12 · TULSA 3 · HOUSTON 2

COMPLETE DRILLING MUD SERVICE

that isn't SWISS CHEESE your Lane-Wells Man is holding

Ask to see that section of

LANE WELLS

KONE-SHOT

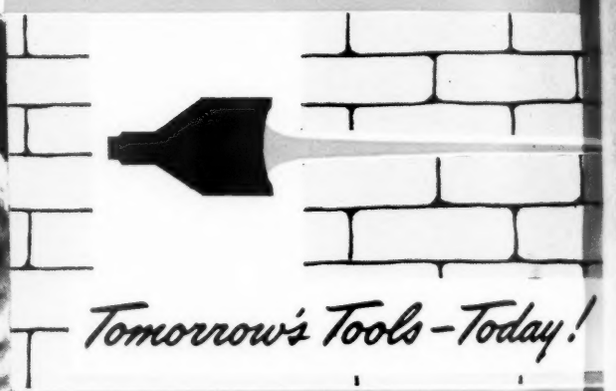
"OPEN HOLE" PERFORATOR

When you look over this powerful shaped-charge perforator, you'll see plainly why it does such an outstanding job of bringing in wells which produce from uncased horizons. Under certain conditions some operators are also using this perforator in cased wells.

EXAMINE THE CARRIER. Both design and in material, the carrier has been carefully designed to provide complete disintegration into fragments about three-quarter inch square in size. This fragmentation gives tremendous "scouring" action on the wall of the hole, and a sand pump or bailer makes quick work of cleaning out the small debris. Carriers can be connected, end to end, to provide any required number of shots on one run.

INSPECT THE CHARGE CASES. Like the carrier, these cast-iron "chambers" disintegrate completely on firing, yet provide complete protection to the shaped-charge against high pressures and high temperatures - - - 5,000 psi at 250°F, 13,000 psi at 200°F.

NOTICE THE FIRING SYSTEM. See how the insulated Primacord which fires the charges is completely contained within the carrier for full protection while running in. Leak-proof cast-iron seals prevent damage to the charges.



CHECK THE RESULTS—

GREAT PENETRATION — Approximately 10 inches into neat cement for 4 ¼" Charge and 15" for the 5 ⅝" Charge.

ACCURATE CONTROL OF EXPLOSIVE EFFECT.

NO "GLAZING" OF FORMATION, as with nitro.

LESS DOWN TIME.

These results have been field proved in many oil fields by many progressive operators.

ASK YOUR LANE-WELLS MAN!

Los Angeles • Houston • Oklahoma City • Lane-Wells Canadian Co. In Canada • Petro-Tech Service Co. In Venezuela
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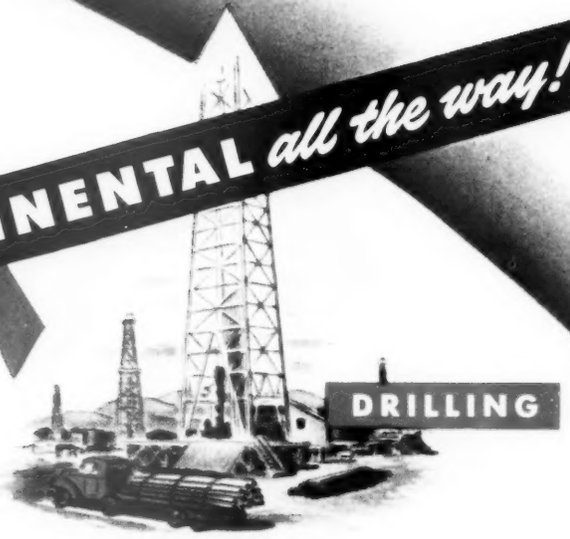
CONTINENTAL *all the way!*



- **QUALITY EQUIPMENT**
- **GOOD SERVICE...**

at the sign of the Green Triangle

There's more to a pumping engine than meets the eye. But your eyes alone will give you four reasons why you should buy CSCO pumping engines.

4 reasons why that meet the eye

You can see for yourself that . . . **1. CSCO engines permit checking or adding oil or water..without a shutdown.**

2. CSCO engines can be easily and quickly repaired on the job. That's because CSCO engines are designed to permit easy access to specially-designed unit assemblies.

3. CSCO engines start easily and safely—with the first spark. No long, back-straining tugging. No kick-back. No need for expensive starters.

4. CSCO engines operate with smooth, steady power. That's because of special governor damping that is exactly suited to extra heavy flywheels.

Behind what you can see there's a story, too. One of satisfied users and years of field experience. Write for bulletin or visit a Continental store.

• **DRILLING** • **PRODUCTION** • **PIPE LINE**

Sound engineering, rugged construction, long-life parts . . . that's why CSCO Engines mean more economical operation to you! In addition to being the outstanding oil pumping engine, the CSCO gives the same top-notch performance in such uses as power generation, lighting, water pumping and other functions calling for a prime mover.

NE PROCESSING — *It's Continental All the Way!*

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CONTINENTAL

all the way!

Call Continental with confidence! Supplies and Equipment for every important operation in the oil and gas industries . . . for rig or refinery, for pipe-line or gas plant. Proven Continental "Green Triangle" Service, provided by 72 Continental stores and offices, is your guarantee of helpful assistance in solving your own equipment or supply problems.

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the oil fields' BEST-KNOWN supply stores are

GENERAL STORES

*that specialize

Last summer, more than 2,000 friends helped us open our modern store at Odessa, Texas. They saw a concrete, brick and steel building 430 feet long, stocked to the roof trusses with oil country goods.

Its modern building is not the secret of why this is a good oil country store. The secret is in the store's more than 12,000 stock cards. You can get anything you need for an oil well at this store. Its inventory is as fabulous as the West Texas and New Mexico oil empire it serves.

At Butler, Pennsylvania, we have another National Supply store, opened about 1895 and still operating. Texas oil men, accustomed to buying parts for their big power rigs in National Supply stores, might be disappointed by the inventory at Butler. But Pennsylvania oil and gas drillers —water well drillers, too—know it is just right for them. Pennsylvania geology dictates a different kind of drilling, and you can get anything you need for a Pennsylvania well at our Butler store.

National Supply stores always tailor their inventories to the needs of the drillers they serve. They may look like general stores to the uninitiated, but every item in each store's stock has use at the wells in its territory.

When you have everything your customers need, and your customers want every item you have, that's good storekeeping. But we carry our meticulous attention to the needs of each customer into many fields besides storekeeping.

It is part of the story behind the fame of our oil field machinery, diesel engines and tubular goods. We build them carefully to do the jobs customers expect of them. As a result, their performance usually surpasses the customers' expectations.

THE NATIONAL SUPPLY COMPANY

General Sales Offices: Toledo, Ohio

NATIONAL BLUE PRODUCTS

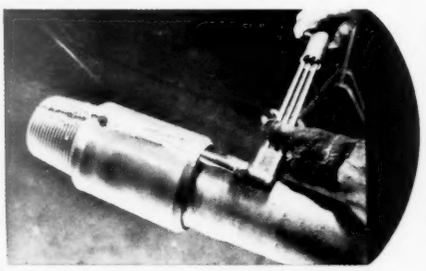
XUM

REPLACE TOOL JOINTS

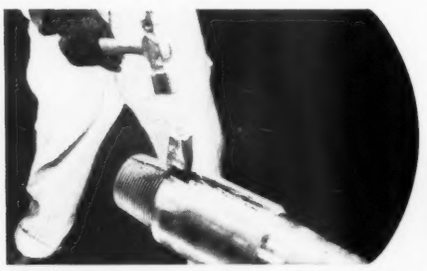
right at the Rig...

- **NO BUCKING-ON REQUIRED**
- **MINIMIZE COSTLY TRUCKING**
- **NO GALLED THREADS**
- **REDUCE SHUT-DOWN TIME**

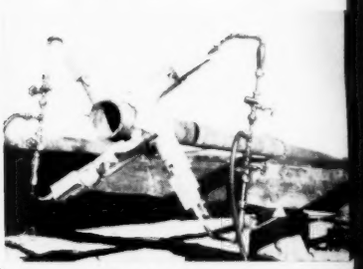
the following steps insure Tool Joint replacement quickly, easily, economically:



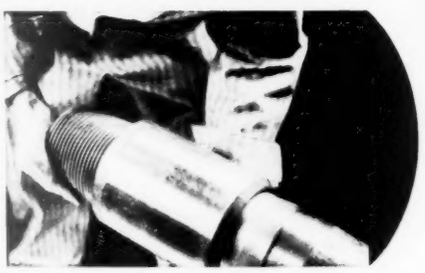
1. Notch the worn Tool Joint with a torch.



2. Wedge-split for fast removal.



3. Small field furnace heats Tool Joint; water spray cools pipe, for second method of removal.



4. Apply new Tool Joint, hand tighten, mark cold position.

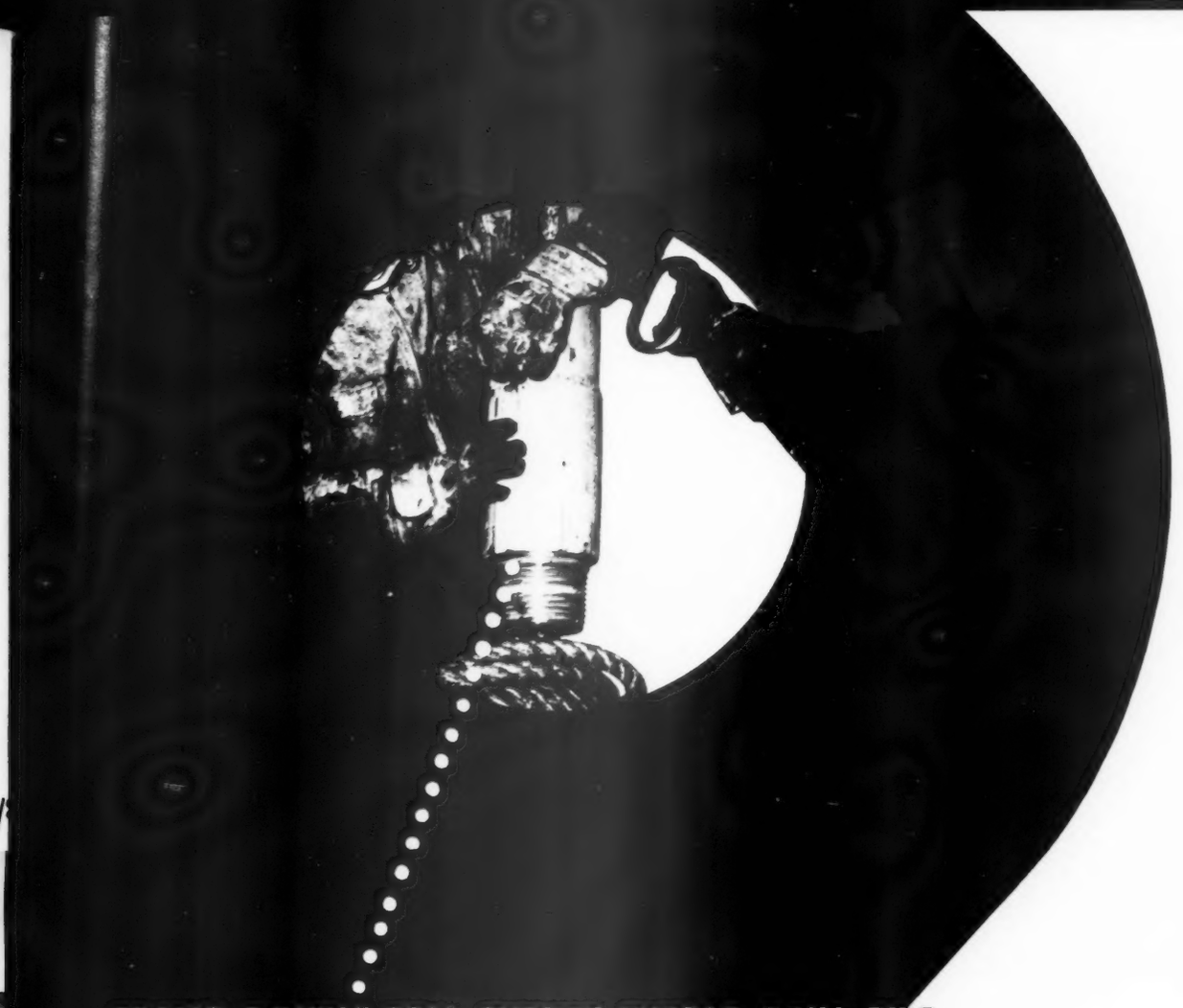
5. Heat new Joint to 800° F. in portable furnace.

6. Bring heated Tool Joint to hot position.

After cooling, Tool Joint and Drill Pipe are firmly joined, resulting in a complete bearing pressure around the entire circumference of the mating sealing surfaces.

Our engineers work constantly to improve the efficiency and dependability of these Spang Double Seal Shrink Thread Drill Pipe and Tool Joint connections.

NATIONAL OIL FIELD MACHINERY AND EQUIPMENT • SPANG PIPE • SUPERIOR & ATLAS ENGINES



SPANG DOUBLE SEAL SHRINK THREAD DRILL PIPE

AND TOOL JOINTS ARE USED WORLD-WIDE

to keep shut-downs to a minimum

to increase drilling profits

With the Spang Double Seal Shrink Thread connection, the function of the threads is to join the units. The carefully machined inner and outer seals provide the essential sealing action. The full circumference mating surfaces prevent washouts, and prohibit entry of fluids into the threads.

We'd like you to have a copy of our bulletin, "Spang Double Seal Shrink Thread Drill Pipe and Tool Joints". It's yours for the asking at your National Supply Store.

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SPANG-CHALFANT DIVISION

NATIONAL BLUE PRODUCTS

look at them

PIECE BY PIECE

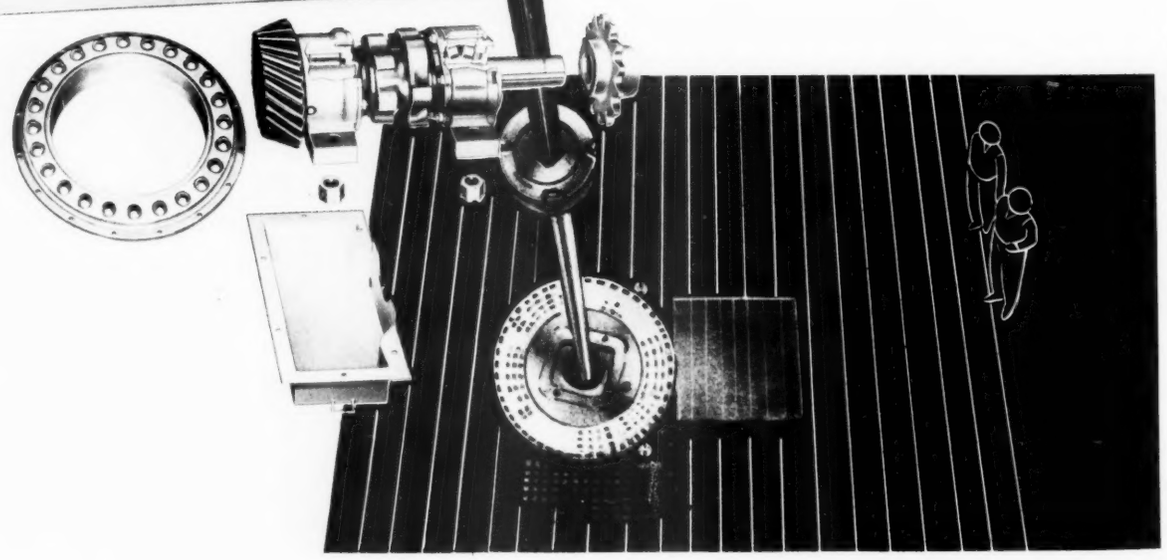
or check the job theyre doing

Either way, you'll find IDEAL ROTARIES measure up to your requirements and with plenty of drilling power to spare.

That's because IDEAL ROTARIES, and all other drilling equipment in the "National Blue" line, are built to the standards of work-to-be-done rather than on the basis of first cost. And that's why IDEAL ROTARIES are so economical in the long run.

The IDEAL ROTARY line is complete, too—machines for shallow-hole drilling or high-speed deep-strata operations. Each unit has special construction features for its service range. These are described in detail in bulletins you can obtain by writing The National Supply Company.

In fact, you'll find everything that's new and everything that's standard in drilling equipment at The National Supply Company.



DIVISION OFFICES: CASPER; FT. WORTH; PITTSBURGH; TULSA; TORRANCE

CANADA: THE NATIONAL SUPPLY COMPANY, LIMITED, ROOM 202, ALBERTA BLOCK, CALGARY, ALBERTA

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THE **NATIONAL SUPPLY** COMPANY

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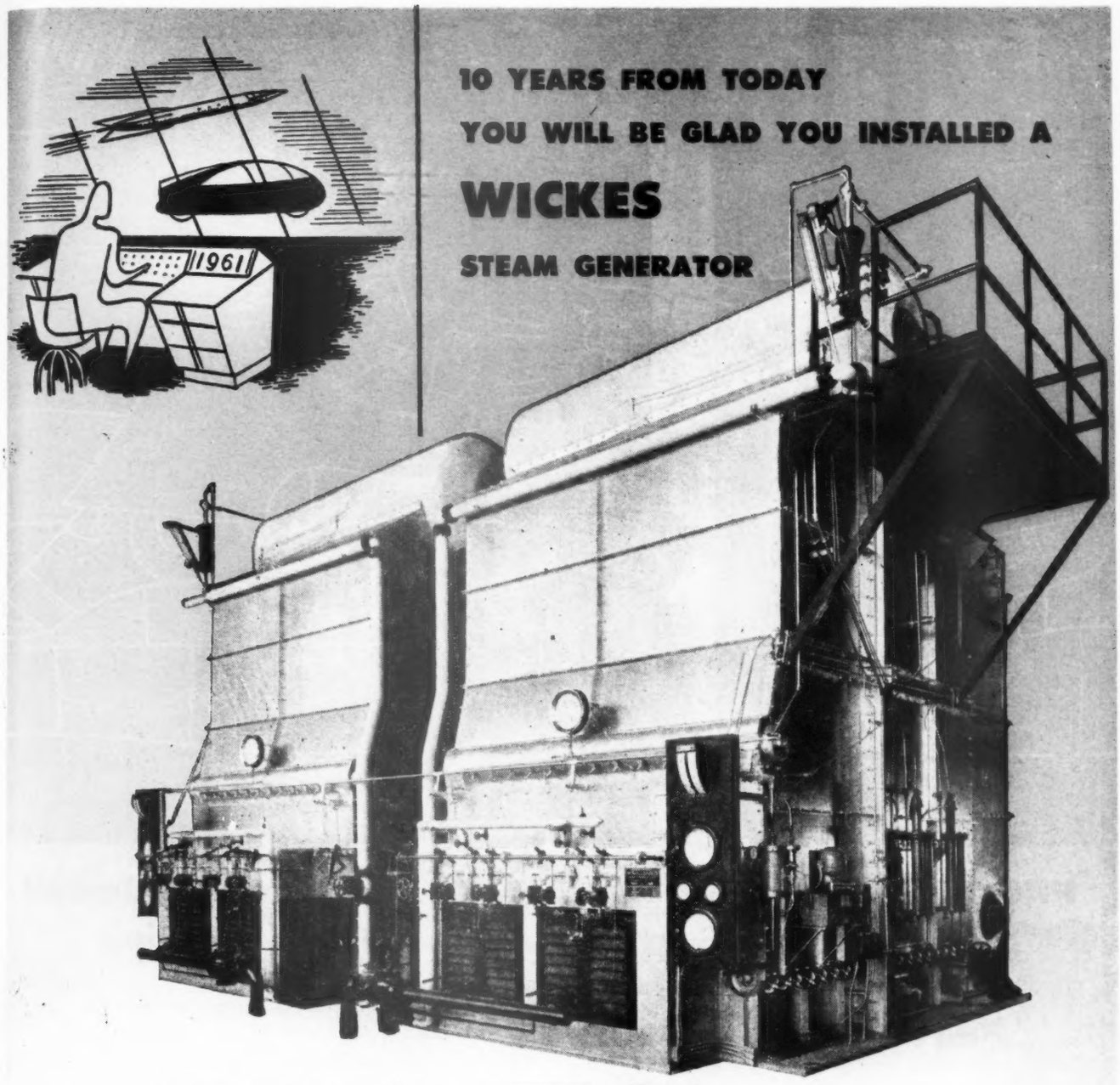

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YOU WILL BE GLAD YOU INSTALLED A

WICKES

STEAM GENERATOR

In 10 years or 20 or even 30 years, your WICKES Boiler will still be going strong. For almost a century now, The Wickes Boiler Company has been leading the field in the manufacture of efficient high-pressure water tube boilers that are really built to last. Throughout the world, industries that depend on steam have learned by long experience that they can depend on WICKES Steam Generators. The Type S 2-Drum Boilers shown here have found wide acceptance in the chemical processing industry because they *are adaptable to any standard method of firing* — oil, gas, single retort underfeed or spreader stoker. Each of these Type S Boilers is capable of delivering 35,000 lbs. of steam per hour. And the low head design makes them especially practical where space is limited. WICKES can fill your requirements for steam generators up to 250,000 lbs. per hour and 950 lbs. per square inch. If you have a boiler problem, our knowledge and experience *is available to you without obligation* . . . write today for descriptive literature on WICKES' complete line of steam generating equipment.

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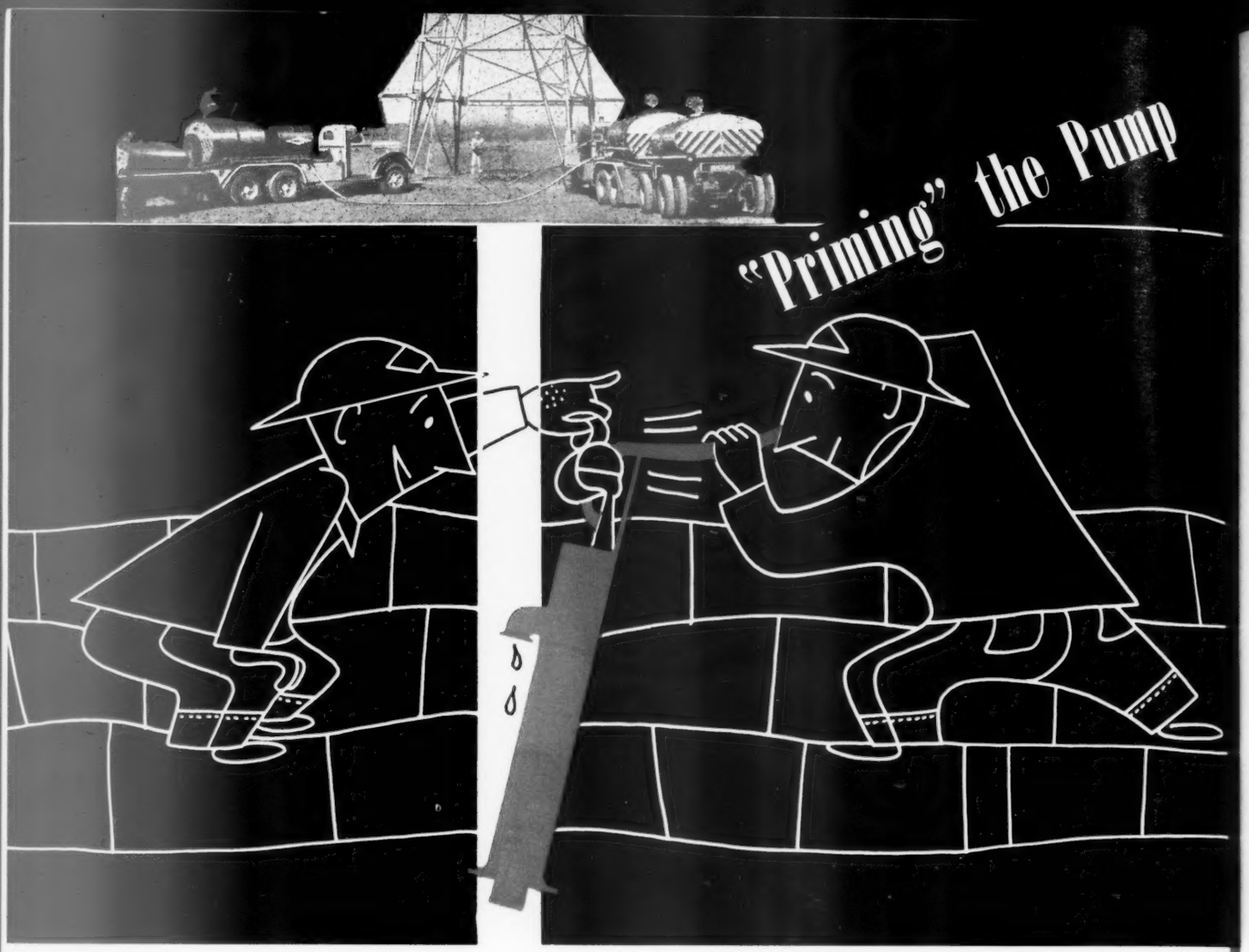


PRODUCTION POTENTIAL INCREASED because Dowell XM Acidizing Service reduced silicate swelling

Dowell Acidizing Service offers you the benefit of 19 years of extensive research and the experience gained in over 100,000 acidizing jobs! When you "Look to Dowell" you get the *right* acidizing treatment in your completion or work-over program.

For example, Dowell's experience has shown that some silicates, those of the clay mineral type found in certain dolomite and limestone producing formations, swell during conventional acid treatments. This silicate swelling not only delays the clean-up of the well after acidizing, thus increasing rigtime, but also can actually reduce oil production. Dowell research tackled the problem and solved it. Now, Dowell XM acid . . . which contains special chemical agents to control silicate swelling . . . is available to you for the profitable acidizing of formations known to contain such silicates.

A well completed in a Permian lime formation, known to contain swelling silicates, tested natural at 65 barrels of oil per day. Although acidizing treatments on comparable wells in the area had never given a potential over 100 barrels of oil per day, a 2000 gallon Dowell XM acid treatment produced a potential of 300 BOPD!

Today, Dowell is still pioneering new techniques and new materials to bring you advanced methods for completing and reworking oil and gas wells. When you need an expert acidizing job, call on Dowell to give you the best. There is a Dowell station near you.

DOWELL, INCORPORATED
TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company

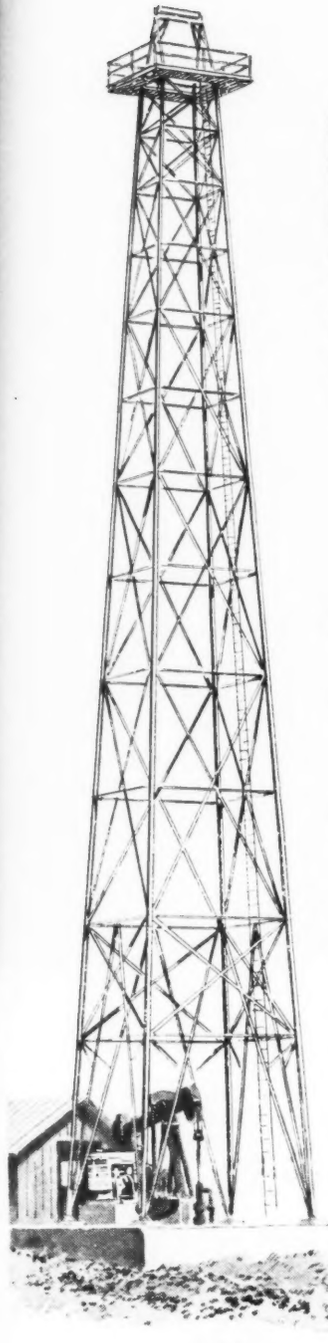
DOWELL
ACIDIZING SERVICE

Ask your nearest Dowell station for complete information on these Dowell services and products: Acidizing Service, Electric Pilot Services, Plastic Service, Chemical Scale Removal Service for heat exchange equipment, Jelflake, Paraffin Solvents, Magnesium Anodes for Corrosion Control and Bulk Inhibited Hydrochloric Acid.

"First in Acidizing . . . since 1932"

Look to DOWELL

FOR OIL INDUSTRY CHEMICAL SERVIC



Quints for Your Crude

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INTERNATIONAL HARVESTER

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5 sizes of power
5 big reasons why

ADAPTABILITY—wide range of use, easily installed

ENDURANCE—proved by thousands of hours of dependable performance

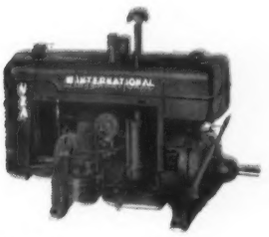
ECONOMY—low-cost maintenance and repairs

SERVICE FACILITIES—all through the oil fields

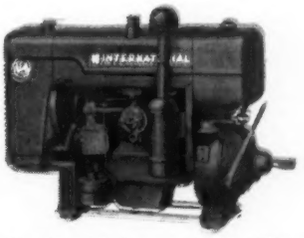
REPUTATION—the International name and all it stands for

INTERNATIONAL HARVESTER COMPANY
CHICAGO 1, ILLINOIS

U-1, 10-5 A.P.I. max. hp. at 1800 rpm.



U-2A, 21.8 A.P.I. max. hp. at 1800 rpm.



U-4, 28.5 A.P.I. max. hp. at 1800 rpm.

U-9, 49 A.P.I. max. hp. at 1500 rpm.

U-6, 37.5 A.P.I. max. hp. at 1500 rpm.

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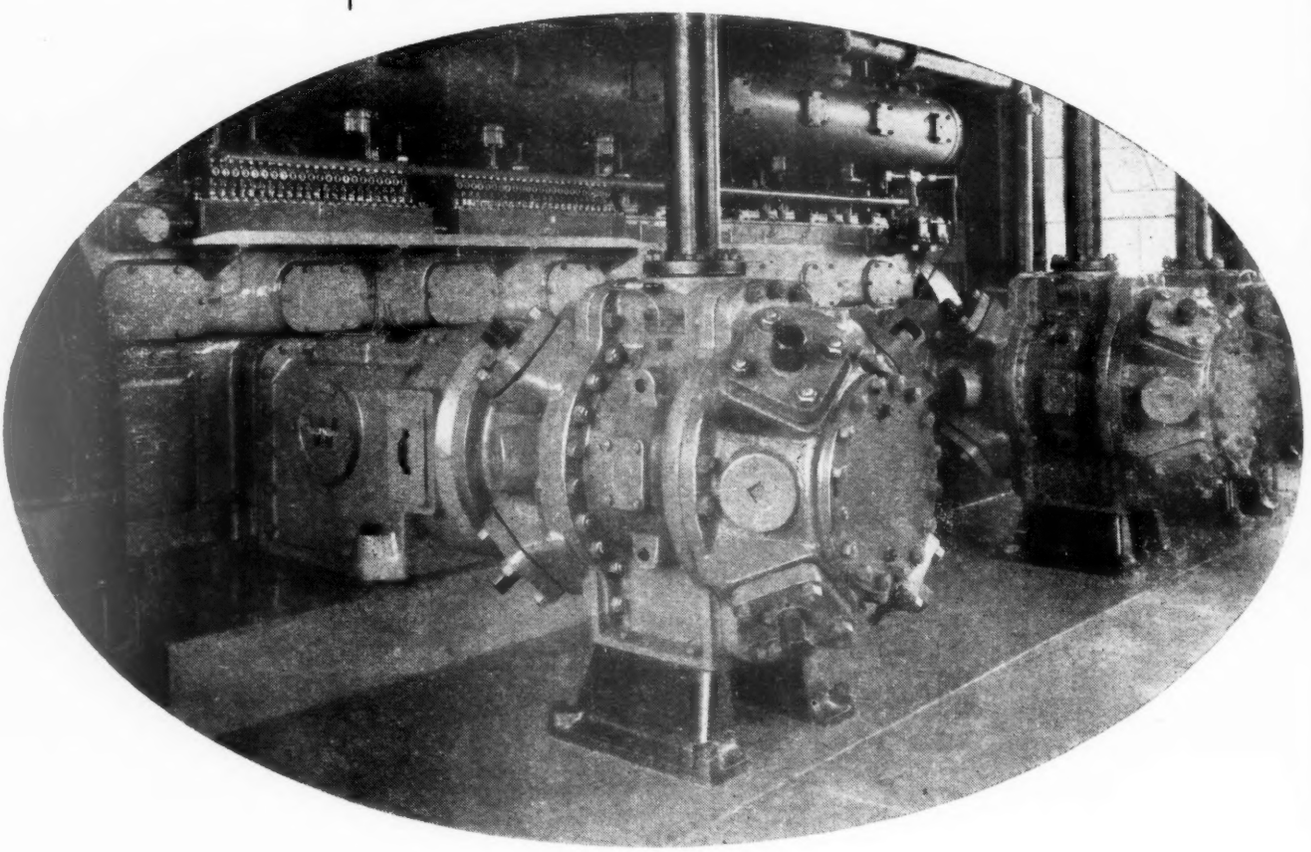
City_____ Zone____ State_____

Insure dependable performance of pipe-line compressor units, reduce maintenance costs with **Gulf Security Oil**



You make a two-way savings when your pipe-line compressor units are lubricated with Gulf Security Oil—lower maintenance costs, less out-of-service time.

Gulf Security Oil provides outstanding protection for bearings and cylinder walls in both engines and compressors. After years of operation with this quality lubricant, equipment shows remarkable freedom from cylinder wear and a minimum of carbon deposits on valves and rings.

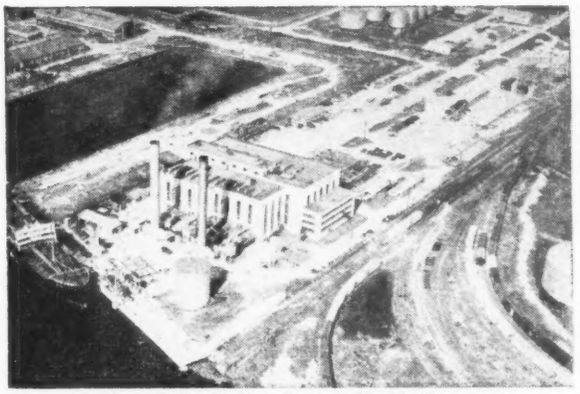
Because of its excellent resistance to oxidation, Gulf Security Oil stands up for many hundreds of hours without appreciable change in its original properties. And because oil control rings are kept clean, oil consumption is remarkably low.

Many operators of units lubricated with Gulf Security Oil report that this quality oil insures more operating hours between overhauls and helps them avoid unscheduled shutdowns. And Gulf's delivery service is tailored to meet the needs of every pipe-line operator.

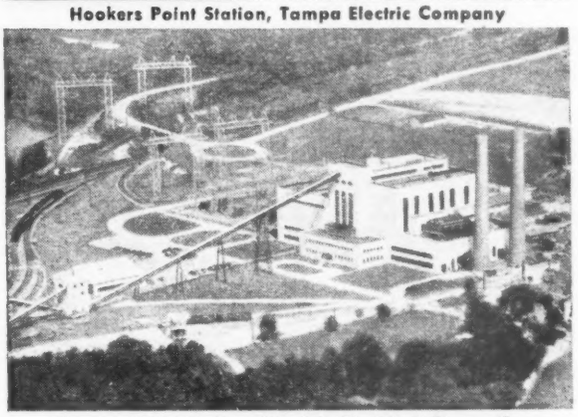
For complete information on Gulf Security Oil and for expert help on any lubrication problem, call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office. Gulf Oil Corporation · Gulf Refining Company, Gulf Building, Pittsburgh 30, Pa.

FIFTY YEARS OF SERVICE
1901 GULF 1951
PETROLEUM AND ITS PRODUCTS

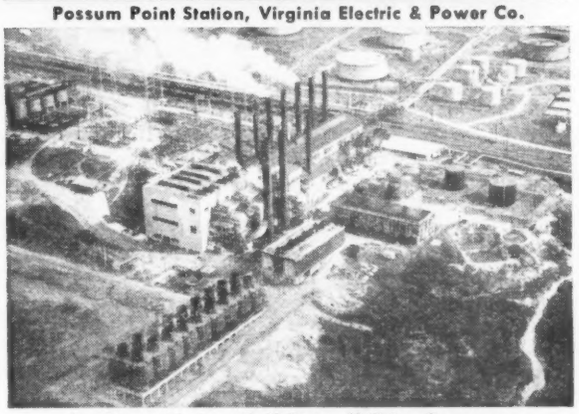
XUM



Hookers Point Station, Tampa Electric Company

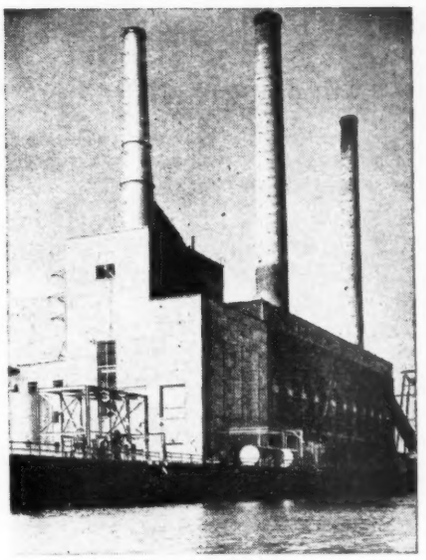


Possum Point Station, Virginia Electric & Power Co.



Louisiana Station, Gulf States Utilities Company

Venice No. 2 Plant, Union Electric Power Company



Riverside Station,
Savannah Electric & Power Company

Designed & Constructed
by
Stone & Webster
Engineering Corporation
and using

OIC Valves are *precision engineered* and *precision built.* OIC engineers offer you *precision application* help.

THE OHIO INJECTOR COMPANY
WADSWORTH, OHIO

OIC
FOUNDED 1883

VALVES

FORGED AND CAST STEEL · IRON · BRONZE

XUM

Building Strength for the Free World

*Highlights from the Annual Report of Standard Oil Company (New Jersey)**

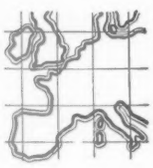
for 1950... a year of record activity

Standard Oil Company (New Jersey) is an American corporation which has, in varying degrees, investments of capital and technical knowledge in a large number of operating oil companies, both in the United States and abroad. In 1950, these companies:

IN THE U. S. A.

Drilled over a thousand new wells, with an unusually high proportion of producers . . . Improved and expanded refineries in New Jersey, Maryland, Louisiana, and Texas . . . Completed a new continuous wax-making plant at Bayonne, N. J. . . . Added 370 miles to Texas crude oil pipeline systems . . . Started doubling the capacity of a products pipeline across Pennsylvania . . . Let contracts to increase by 85% the capacity of a pipeline from Baton Rouge to the Southeastern states . . . At government request, re-activated two government-owned Butyl rubber plants; also continued operating two others which have been producing constantly since 1943 . . . Invested over 20 million dollars in laboratory research for new and improved processes and products.

IN WESTERN EUROPE



Proposed a plan which ended gasoline rationing in England . . . Went ahead of schedule in construction of a new refinery at Fawley, England, to be the largest in Europe . . . Expanded, improved or started construction of refineries in Norway, Belgium, West Germany, France, and Italy . . . Opened many new service stations, which served not only local motorists, but some 18,000 American tourists . . . Supplied 28% more fuel oil than a year ago, to meet needs for industrial expansion . . . Met the greatest demand for asphalt for new road building ever experienced in these areas.

IN THE MIDDLE EAST

Stepped up oil production substantially in Saudi Arabia . . . Opened the vitally important Trans-Arabian Pipeline system from oil fields on the Persian Gulf to the Mediterranean . . . over 1,000 miles of 30- and 31-inch pipe . . . Started construction of a large-diameter pipeline extending 550 miles from Iraq to the Mediterranean.

IN THE FAR EAST

Expanded production of crude oil in Indonesia and explored for oil in Papua . . . Increased output of refineries in Australia, Sumatra, Japan.

IN CANADA

Produced nearly 50% more oil than a year ago . . . Made new oil and gas discoveries in Ontario and Alberta . . . Operated nine refineries at 14% greater output than a year ago . . . Opened a new 1,100-mile pipeline system from Alberta to Lake Superior, to carry crude oil toward the major Canadian refineries and markets.

IN SOUTH AMERICA

Set a new production record in Venezuela, second largest oil-producing country in the world . . . Operated the big Aruba refinery in the Netherlands West Indies at a higher rate than ever before . . . Met sharply increased call for products throughout the continent, to support the vigorous post-war development.

IN OCENA TRANSPORT

Received the last 4 of 12 super-tankers ordered two years ago . . . Ordered 6 more new tankers . . . Operated an ocean-going tanker fleet of 117 vessels, totaling over 2 million deadweight tons.

IN EMPLOYEE RELATIONS

Continued the same favorable labor relationships that have prevailed for more than three decades, with no strikes in domestic operations.

THE YEAR ENDED . . . THE JOB GOES ON. In 1950, for the first time, world use of oil outside the Iron Curtain passed 10 million barrels a day. For comparison, it was just over 7 million in 1945, the peak war year.

This is significant to free people everywhere. Oil supplies in today's world are closely linked to living standards and national strength.

It seems clear that more and more the world will look to oil to help keep it free and progressive. More and more it becomes clear, in meeting that need, that the American-developed business process of risk and result . . . of competition spurring corporate ingenuity and responsibility . . . is a strong and flexible system for promoting the welfare of people.

* We will be pleased to send a copy of the full report to anyone wishing it. Write Room 1626, 30 Rockefeller Plaza, New York 20, N. Y.

FINANCIAL SUMMARY

Standard Oil Company (New Jersey) and Consolidated Affiliates

Total income from sales, services, dividends and interest . . $3,198,266,000	Taxes collected for governments . . $294,749,000
Net income . . . $408,223,000 or $13.48 per share	Wages and other employment costs . . $548,205,000
Dividends . . . $151,028,000 or $5.00 per share	Spent for new plants and facilities . . . $295,132,000
Taxes paid . . . $276,000,000	Number of stockholder-owners 222,000
	Number of employees 116,000

STANDARD OIL COMPANY (NEW JERSEY)

AND AFFILIATED COMPANIES

To obtain more information on products advertised see page E-45

Steel saved civilization at Augsburg

FOR 2000 years, the western world has survived vast waves of Asiatic invaders who threatened to destroy it. Repeatedly, the fate of civilization and Christianity has seemed to hang on the outcome of a single battle.

Such a decisive action was fought at Augsburg, South Germany, in 955 A.D. Swarming out of Asia, savage Magyars overran the rich Danube Valley. They ravaged the prosperous lands of Germany, Italy and France. At last, under Otto, King of Saxony, the armored Knights of Christendom rallied. They faced a hundred thousand fierce foes. The battle raged all day. Thousands were slain. At last the tide turned and the Magyars fled. For three days the Knights pursued the scattered enemy, killing or capturing thousands more. Symbolic of the west's predominance in weapons and armor of iron and steel, victory was credited to King Otto's iron-tipped Holy Lance.

Augsburg ended the Magyars' attempts to conquer Europe. They settled down to peaceful living in their valley and within 50 years accepted Christianity. Again, history demonstrated the truism that no people or alliance can establish supremacy unless it first predominates in the production and use of iron and steel.

It is reassuring that America produces twice as much steel as the rest of the world combined. America has the steel to win. We will use enough of it to protect our leadership of a free Christian world.

Scrap Metal is Critical Again

The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment.

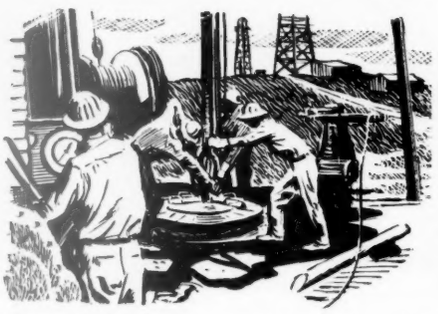
XUM

"Why should you be in all parts of the oil business?"

Mrs. Henry Lincoln, housewife in Boise, Idaho, asks: *"Do you have to be in all parts of the oil business? Why don't you just produce or refine, and give other companies a chance to do the transporting, selling, etc.?"* Mrs. Henry Lincoln

Why *all* parts? Take the example of how Standard serves Idaho and eastern Oregon. Time was when severe winter weather often delayed deliveries. Costs seemed high. Here was a *need*, a *demand*.

Some 600 miles away in Colorado was a possible source of additional fuel—the old Rangely oil field, long undeveloped. Standard studied the *demand* and the *supply*, decided to bring them together.

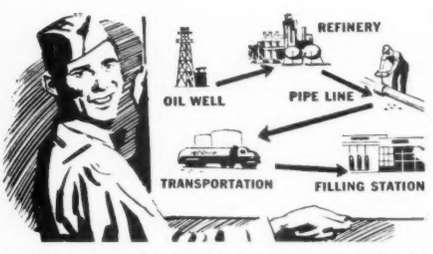


That called for a complete, *integrated* operation—getting the crude out of the ground, refining it, delivering it to users—all carefully planned ahead. So new wells were drilled at Rangely.

And to move the crude. Standard laid a pipeline to Salt Lake City. This called for an especially big investment because the 182 mile long line is the world's highest: crosses the Uinta Mts. at 9560 feet.

Next—a new Standard refinery at Salt Lake City. It cost over $15 million. But to keep costs down, it must operate continuously—have constant supply of crude, constant movement of product.

Another long pipeline was then built on up to the Northwest. Gasoline and fuel oil made from Rangely crude now go where they're needed—lower in cost, plentiful no matter how tough the winter.



If Standard had not been prepared—in *size*, in *integrated skills*, in *investment capital*—to tackle this job as it did, it could not have done this job at all. As it is, we are able to serve a large area *well*.

I'd Like to Know . . .

You may have heard that a suit has been filed by the Antitrust Division in Washington, D. C. to break up Standard of California as well as six other West Coast oil companies. Many people have written us protesting this action, have asked pertinent questions. We believe these questions should be answered for everyone. We take this way of doing so. If you have a question, write:

"I'd Like to Know"
225 Bush Street, San Francisco 20

STANDARD OIL COMPANY OF CALIFORNIA

• plans ahead to serve you better

Why the *FIRST* names in pipelines depend on the *FIRST** name in line pipe

*FIRSTS by A. O. SMITH • Welded line pipe • Internal expanded pipe • Light wall large diameter pipe • World's largest producer of large diameter welded steel line pipe

• When it's A. O. Smith Line Pipe — it's round and it lines up for easy welding. Why? Because A. O. Smith's internal expanding process makes sure of that by stressing the pipe beyond its yield point—and when pipe is stressed beyond its yield point by uniform internal expansion it automatically comes out round, straight and consistently of the right diameter. This process produces pipe of high yield strength — lighter, stronger line pipe — without using expensive alloy steel. The result: higher operating pressures at lower cost per mile and weldability without recourse to special welding practices.

A. O. Smith Line Pipe is available in a complete range of sizes and wall thicknesses, from 8⅝ in. to 36 in. in diameter.

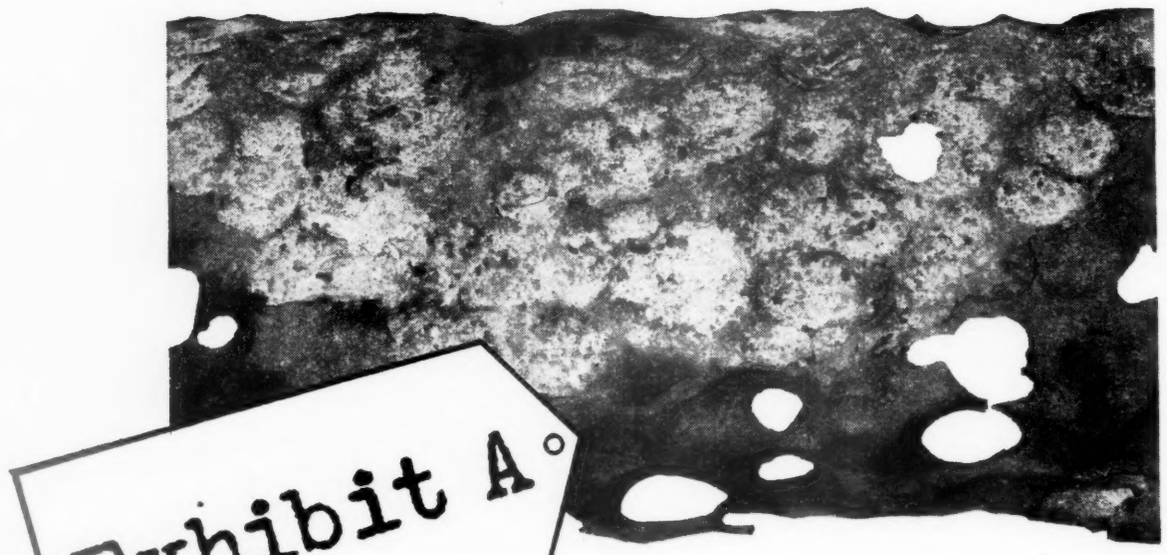
DEPENDABILITY *through* **RESEARCH** *and* **ENGINEERING**

A.O. SMITH 77th ANNIVERSARY 1874 - 1951

A.O.Smith

LINE PIPE • CASING

Atlanta 3 • Chicago 4 • Dallas 2 • Denver 2
Houston 2 • Los Angeles 12 • New York 17
Phoenix • Pittsburgh 19 • Salt Lake City 1
San Diego 1 • San Francisco 4
International Division: P.O. Box 2023, Milwaukee 1



in the CASE AGAINST CORROSION

Corrosion like this costs the petroleum industry millions of dollars each year. You've seen the ugly evidence a thousand times — engines that have rusted away hours of useful life, derricks, oil storage tanks, drilling equipment. Every piece of your equipment made of metal is subject to the ravages of rust.

Rust-Ban protective coatings offer you a practical defense against corrosion. There is a proven Rust-Ban coating for every piece of your equipment. Field tests show Rust-Ban cuts maintenance costs and lowers the frequency of equipment replacement — you save first cost many times over.

RUST-BAN 274 and 295 are designed to protect oil storage tanks and other metal structures. Rust-Ban 274 is a fast-drying zinc chromate primer and Rust-Ban 295 is a high-quality aluminum finish.

RUST-BAN 330 is perfect protection for equipment to be stored. Good for machined parts or threads.

RUST-BAN 331 gives interior and exterior protection for precision machinery. Comes off easily upon application of a petroleum solvent.

RUST-BAN 623 is ideal for lay-away protection of all types of internal combustion engines.

These are typical uses of five of the many Rust-Bans. Technical service engineers of any Rust-Ban distributor stand ready to offer specific recommendations for the protection of your equipment.

RUST-BAN

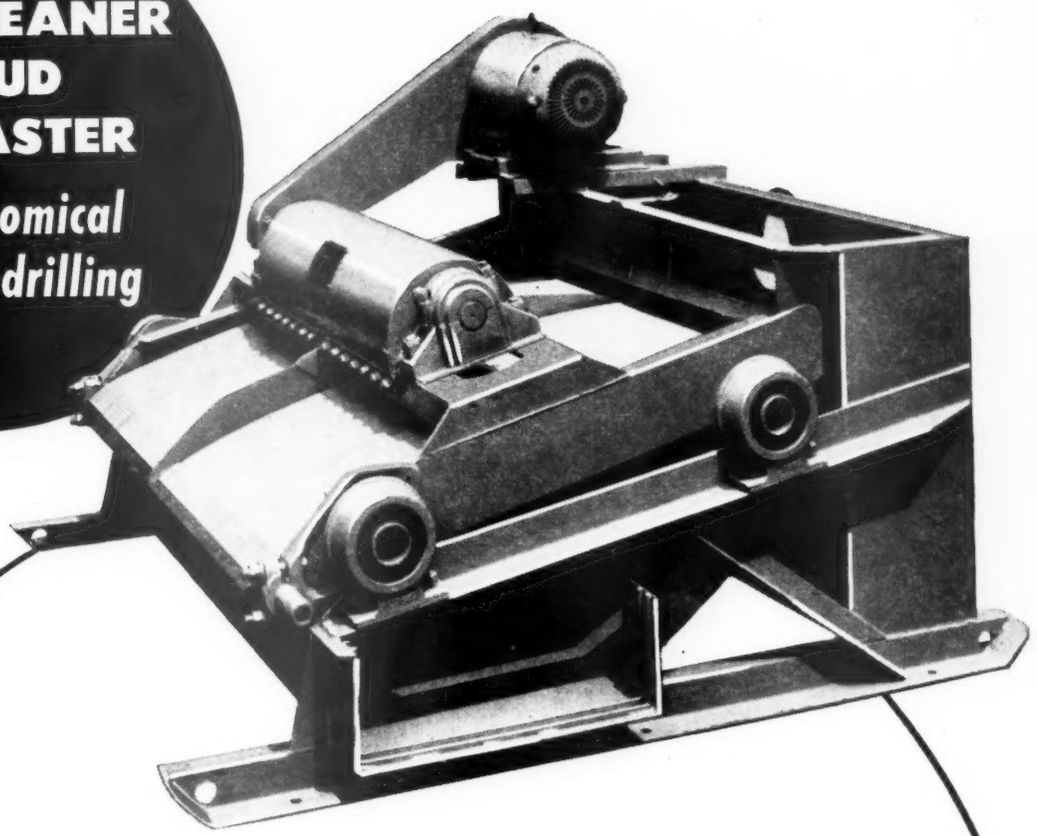
REG. U. S. PAT. OFF.

RUST-BAN MARKETERS

Humble Oil and Refining Co., Houston, Texas
Standard Oil Company (Kentucky), Louisville, Ky.
Penola Oil Co., Detroit, Mich.
The Carter Oil Company, Denver, Colo.
Esso Standard Oil Company, New York, N. Y.

GET CLEANER MUD FASTER

for economical efficient drilling



The McNeely Vibrating Mud Screen, Model L-9*, is worth looking into when it comes to screening mud at low cost and high volume. The L-9 has an average capacity of 850 gpm—equal to the output of the largest mud pumps. Its unbalanced shaft, which imparts the high frequency elliptical vibrating motion to the screen, is mounted between two SKF Spherical Roller Bearings. That means the bearings receive real brute punishment. Thus, they are a major factor in the L-9's dependable, smooth operation. Builders of all types of oil field equipment rely more and more on SKF. They recognize SKF's proved ability to help put the right bearing in the right place.

7254

*For detailed information on the McNeely Vibrating Mud Screen and other equipment, write Vernon Tool Co., Ltd., 1101 Meridian Ave., Alhambra, California.

SKF

BALL AND ROLLER BEARINGS

8 REASONS WHY SKF IS PREFERRED BY ALL INDUSTRY

- integrity
- craftsmanship
- metallurgy
- tolerance control
- surface finish
- product uniformity
- engineering service
- field service

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.
—manufacturers of **SKF** *and* HESS-BRIGHT *bearings.*

Know your valve
Do's and don't's for better piping service
Variations in stem operation of gate, globe, and angle valves
The different types of bonnet joints on gate, globe, and angle valves
PIPING POINTERS
HELPFUL HINTS ON THE APPLICATION AND MAINTENANCE OF PIPING EQUIPMENT
INCLUDING THE CRANE VALVE SELECTION GUIDE

Just Out!

NEW 36-PAGE EDITION OF

PIPING POINTERS

...a bigger, more helpful handbook for training maintenance workers

You asked for ¼ million copies of the last edition of Piping Pointers. You found it a big help in training beginners and refreshing veterans in your piping crews. The bigger and better edition is just out—changed in appearance but not in purpose. Crane again offers this booklet—to help keep your piping systems at peak efficiency.

Piping Pointers talks facts . . . not theory. Thoroughly covers the fundamentals of good, sound, everyday piping practices . . . in easy-to-grasp, nontechnical language. Its many "how-to-do-it" features are illustrated for easy understanding.

Mistakes in piping installation and maintenance cost more today. Piping Pointers can help your men avoid them. Just ask your Crane Representative for a copy.

PARTIAL INDEX TO PIPING POINTERS

HOW TO choose valves for every service . . . install valves . . . read reducing fittings . . . make up screwed joints . . . assemble flanged joints . . . make up solder joints . . . install pressure regulators . . . use vent and drain valves . . . avoid steam trap trouble . . . save on pipe joints and materials . . . handle piping tools.

plus THE CRANE VALVE SELECTION GUIDE

which saves time and effort in selecting valves for common piping services.

PIPING POINTERS 16-mm SOUND FILM
Free Usage for Group Training

A 30-minute motion picture that dramatizes the fundamental information in the Piping Pointers Manual. Ideal for classroom or plant training groups. Available on request through your local Crane Branch.

CRANE

CRANE CO., *General Offices:*
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

To obtain more information on products advertised see page E-45

SINCLAIR RESEARCH LABORATORIES—nine buildings containing the most modern testing equipment known—have contributed many of today's most important developments in the field of petroleum products, production and refining. Under the Sinclair Plan, the available capacity of these great laboratories is being turned over to work on the promising ideas of inventors everywhere.

An Open Door to Inventive Americans Who Need Laboratory Facilities

The SINCLAIR PLAN will open up the Company's great laboratories to every American who has an idea for a better petroleum product

A ROAD BLOCK stands in the path of American inventiveness today—it is the need for large and expensive laboratory facilities in developing and proving out new ideas.

This was no obstacle in our earlier days. Eli Whitney built his cotton gin with homemade tools in a barnyard. In contrast, the recent development of nylon took ten years of research time and 70 millions of dollars.

In short, the man with a new idea today bumps up against our complex technology and often finds that he is at a loss to prove out his invention without the help of great laboratories and an army of specialists. And how can the individual get the use of such facilities?

To break down this road block to outside invention within the petroleum field, we offer the Sinclair Plan.

The Sinclair Research Laboratories at Harvey, Illinois, have nine modern buildings equipped to handle every phase of petroleum research.

If you have an idea for a better petroleum product or for a new application of a petroleum product, you are invited to submit it to the Sinclair Research Laboratories, with the provision that each idea must first be protected, in your own interest, by a patent application or a patent.

If the directors of the laboratories select your idea for development, they will make, in most cases, a very simple deal with you: In return for the laboratories' investment of time, facilities, money and personnel, Sinclair will receive the privilege of using the idea free from royalties. This in no way hinders the inventor from selling his idea to other companies or from making any kind of arrangements he wishes without further reference to Sinclair.

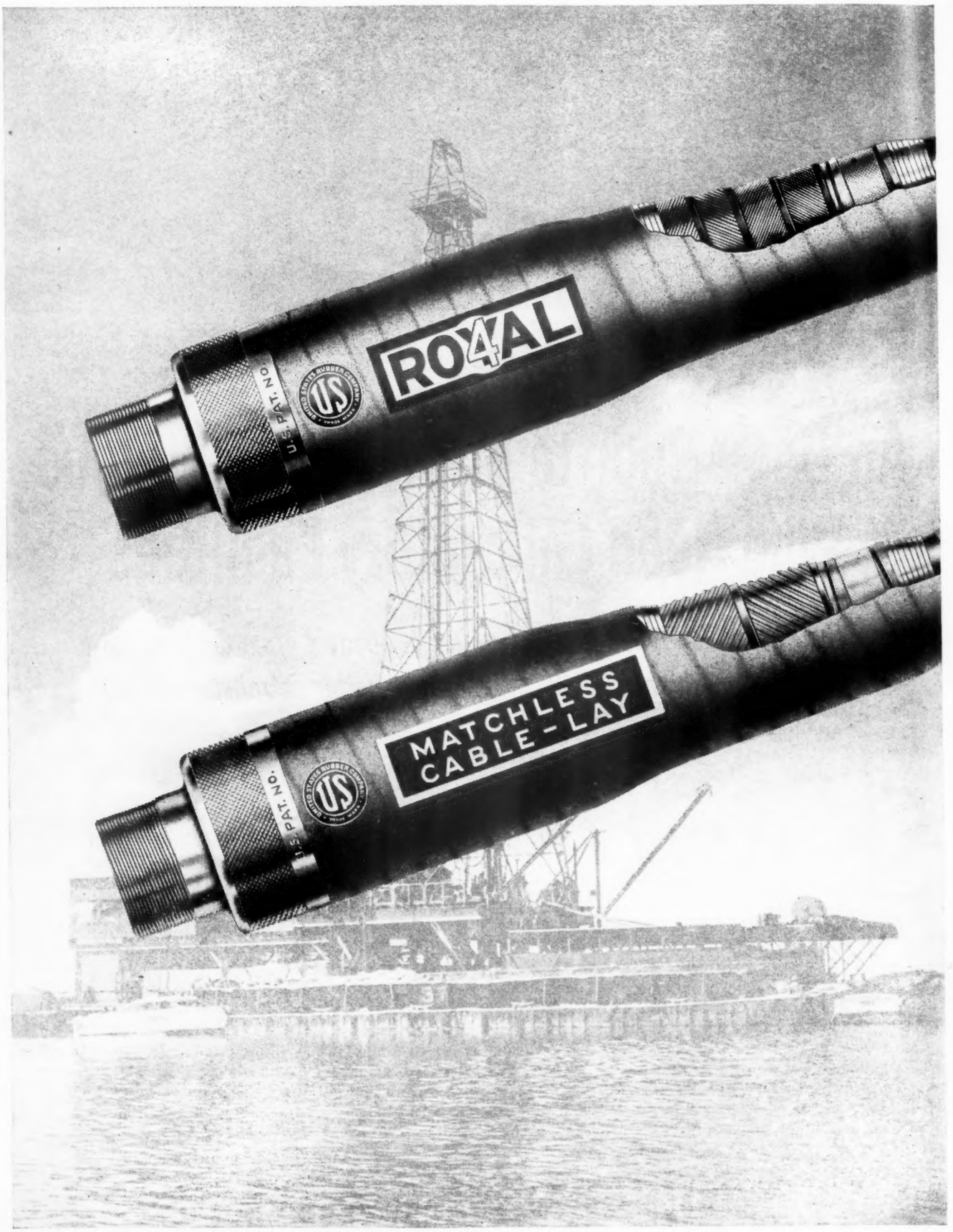
How to Participate

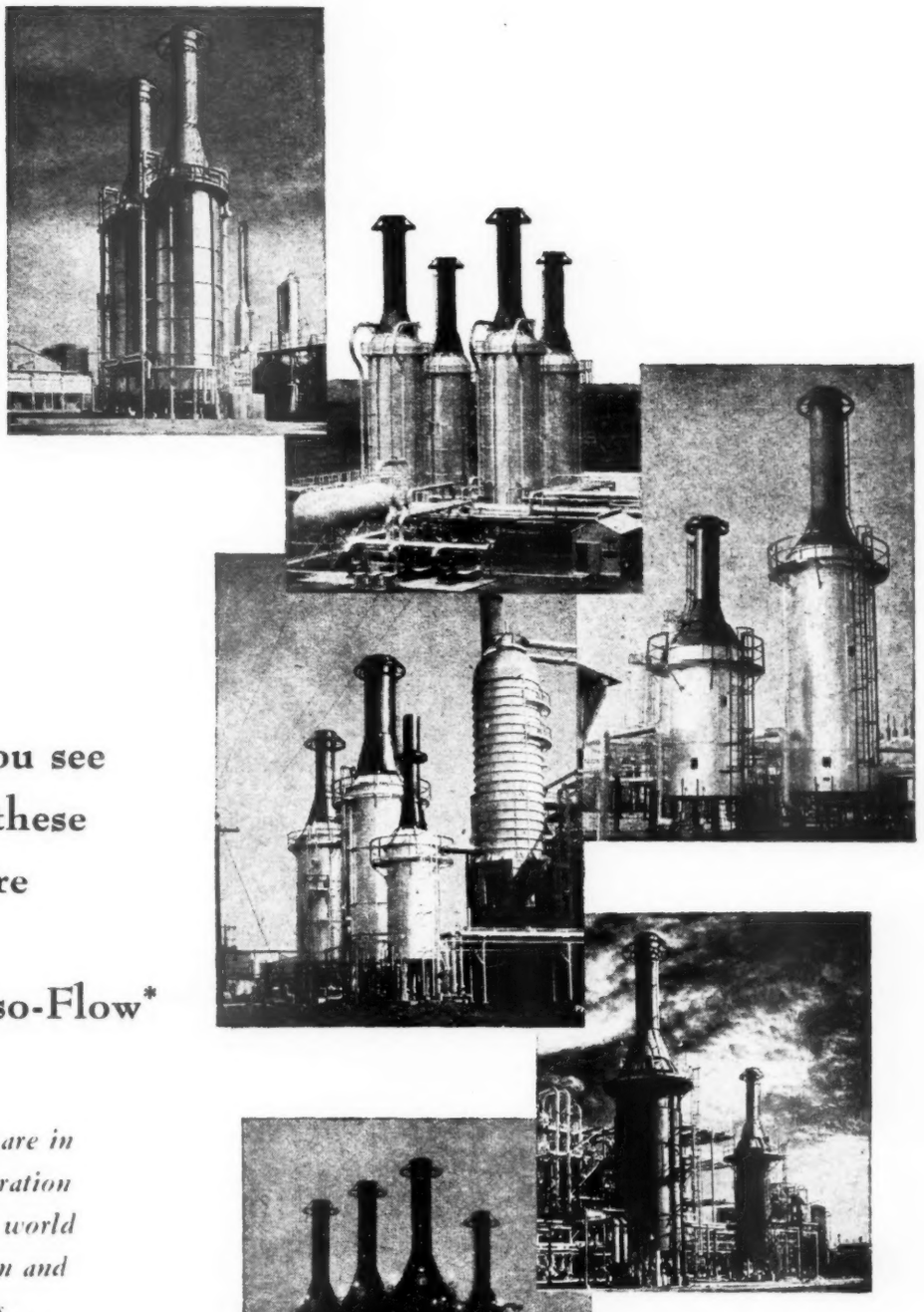
Instructions on how and where to submit ideas under the Sinclair Plan are contained in a complete Inventor's Booklet that is available on request. Write to the office of the Executive Vice-President, Sinclair Research Laboratories, Inc., 630 Fifth Avenue, New York 20, N. Y. for your copy of this booklet.

IMPORTANT: *Please do not send in any ideas until you have sent for and received the booklet of instructions.*

SINCLAIR—A Great Name in Oil

Greatest Success





Whenever you see furnaces like these you can be sure they're Petro-Chem Iso-Flow* design

More than 750 are in satisfactory operation throughout the world in the petroleum and allied industries . . . for all processes and for any capacity.

*Reg. U. S. Pat. Off.

PETRO-CHEM ISO-FLOW FURNACES

UNLIMITED IN SIZE . . . CAPACITY . . . DUTY

PETRO-CHEM DEVELOPMENT CO., INCORPORATED

120 EAST 41ST STREET, NEW YORK 17, N. Y.

Representatives: Bethlehem Supply, Tulsa and Houston · Flagg, Brackett & Durgin, Boston · D. D. Foster, Pittsburgh · Faville-Levally, Chicago · Lester Oberholz, California

There's a Petro-Chem Iso-Flow Furnace and Boiler for every service, capacity or duty irrespective of temperature pressure ranges . . . none too small or too large . . . more than 750 in operation throughout the world in the petroleum and allied industries performing with utmost satisfaction . . . and in many instances operating in excess of their design capacity by more than 50%.

The Handy Durable RIDGID Bench Yoke Vise

● You save time and effort with this more-for-your-money RIDGID Bench Vise. Right where you need 'em are its intregral pipe rest and benders that won't flatten pipe—and heat-treated tool-steel LonGrip jaws mean you don't have to be so fussy with polished pipe. Special malleable frame, extra durable. 8 sizes to 6″ pipe, bench, post, stand and Tristand models, yoke and chain. Order from your Supply House.

RIDGID

★ Work-Saver Pipe Tools ★

THE RIDGE TOOL CO. • ELYRIA, OHIO

MEETINGS

June 14-15—Pennsylvania Grade Crude Oil Association, 1951 Annual Meeting, Hotel William Penn, Pittsburgh.

June 16-20—Canadian Gas Association, Bigwin Inn, Lake of Bays, Ontario, Canada.

June 17-20—Petroleum Equipment Suppliers Association, Cha eau Frontenac, Quebec, Canada.

June 18-22—American Society for Testing Materials, Annual Meeting, Atlantic City, N. J.

June 25-29—Twenty-Third Annual Conference of the Oil and Gas Power Division, American Society of Mechanical Engineers, Baker Hotel, Dallas, Texas.

July 19-20—Western Petroleum Refiners Association (regional meeting) Joint Technical-Industrial Relations Meetings, Broadview Hotel, Wichita, Kansas.

July 31-Aug. 3—Wyoming Geological Association, Rawlins, Wyoming.

Aug. 13-15—Society of Automotive Engineers, Inc., West Coast Meeting, Olympic Hotel, Seattle, Washington.

Aug. 17—Western Petroleum Refiners Association, Leonard Refineries Auditorium, Alma, Michigan.

Sept. 3-7—American Chemical Society, 120th National Jubilee Meeting, Hotel Statler, New York City.

Sept. 4-6—Pacific Coast Gas Association, Annual Convention, Fairmont Hotel, San Francisco, California.

Sept. 5-8—Oil Industry Information Committee, Waldorf-Astoria Hotel, New York, N. Y.

Sept. 6-7—Michigan Petroleum Association (Annual Fall Convention), Ramona Park Hotel, Harbor Springs, Michigan.

Sept. 8-9—International Union of Pure and Applied Chemistry (16th Conference), Hotel Statler, New York City.

Sept. 10—New York Oil Heating Association, Inc., Hotel Statler, New York City.

Sept. 10-14—Instrument Society of America, National Conference and Exhibit. Sam Houston Coliseum, Houston, Texas.

Sept. 12-14—National Petroleum Association, Hotel Traymore, Atlantic City, New Jersey.

Sept. 16-19—American Institute of Chemical Engineers, Regional Meeting, Sheraton Hotel, Rochester, New York.

Sept. 16-19—American Institute of Chemical Engineers (Regional), Sheraton Hotel, Rochester, New York.

Sept. 20-21—Western Petroleum Refiners Association, Hotel Henning, Casper, Wyoming.

Sept. 21-23—American Association of Oil Well Drilling Contractors, Eleventh Annual Meeting, Texas Hotel, Fort Worth, Texas.

Sept. 23-25—American Association of Oilwell Drilling Contractors, Fort Worth, Texas.

Sept. 25-28—The American Society of Mechanical Engineers (Fall Meeting), Radisson Hotel, Minneapolis, Minn.

Oct. 4-5—California Natural Gasoline Association (26th Annual Fall Meeting), Ambassador Hotel, Los Angeles, California.

Oct. 8-9—Texas Mid-Continent Oil and Gas Association, Annual Meeting, Beaumont, Tex.

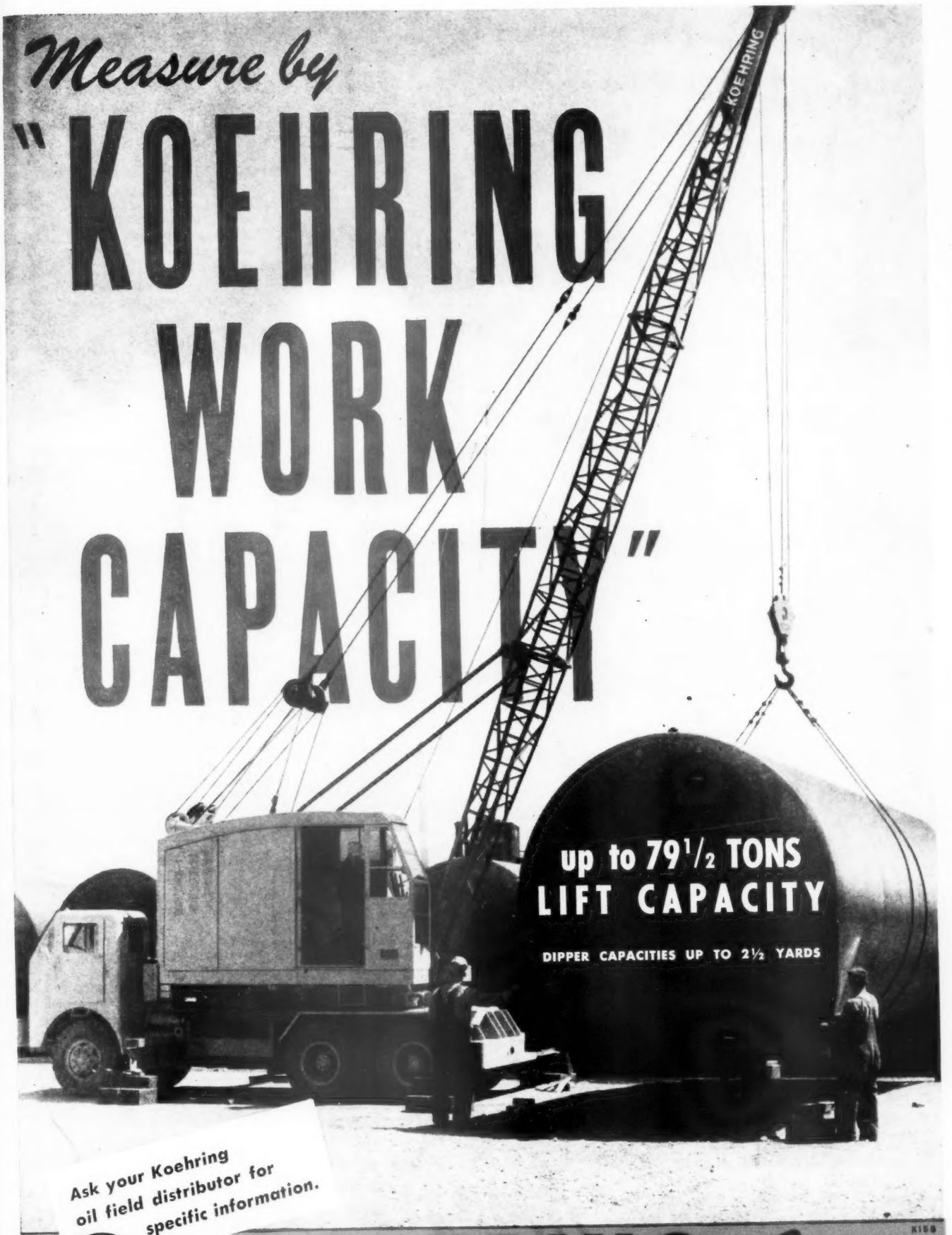
AIME, Petroleum Division

Fort Worth, Texas—First and Third Wednesdays.

Dallas, Texas—Second and Fourth Wednesdays each month.

Measure by

"KOEHRING WORK CAPACITY"



Ask your Koehring oil field distributor for specific information.

K158

KOEHRING *Cranes*

KOEHRING COMPANY, Milwaukee 16, Wis. Subsidiaries: PARSONS • KWIK-MIX • JOHNSON

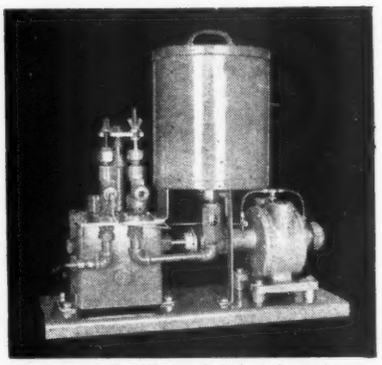
XUM

Fast Expanding to meet your needs

...the *Manzel* Chemical Feeder Line

NEW Rotary Gas Drive Feeders

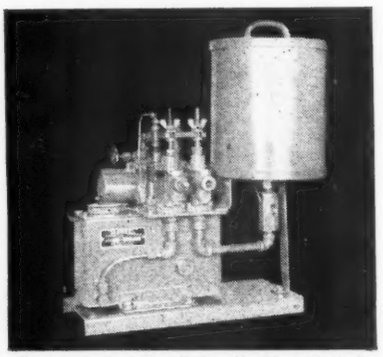
Efficient, dependable, Rotary Drive Motor operates on as low as 3 lbs. pressure.



Rotary Gas Drive Self-Lubricated

NEW Self-Lubrication

Automatic built-in system assures *complete* lubrication of Gas Motors, protects against corrosion and frequent stoppage. Available in either Rotary or Reciprocating Drive, and in kit for converting your present motor.



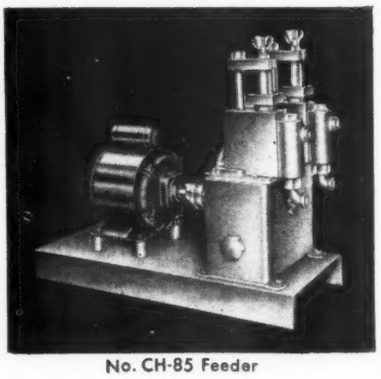
Reciprocating Gas Drive, Self-Lubricated

NEW Extra Large Series '85' Feeders

Adjustable to pump up to one gallon of liquid per minute per feed.

PLUS

Numerous other models, ranging in capacity from a few drops to 17.5 gallons per hour per feed.



No. CH-85 Feeder

Though Manzel Chemical Feeders are widely used and respected throughout the petroleum industry, we are working every day to add improvements, new features, and new models to the line. The new equipment described above is similar in principal to the other 'time-tested' Manzel Chemical Feeders, automatically injecting the chemical in exact proportion to the amount of liquid being pumped. Multiple units may be supplied with any number of feeds. Ask your Manzel Representative for details, or write...

Manzel

291 Babcock Street
BUFFALO 10, N. Y.

Oct. 8-10—The American Oil Chemists Society (Fall Meeting), Edgewater Beach Hotel, Chicago, Illinois.

Oct. 14-20—Oil Progress Week.

Oct. 15-17—American Gas Association, Annual Convention, St. Louis, Missouri.

Oct. 15-17—American Petroleum Credit Association (27th Annual Conference), Adolphus Hotel, Dallas, Texas.

Oct. 15-17—American Gas Association (Annual Convention), Kiel Auditorium, St. Louis, Mo.

Oct. 15-19—National Metal Congress and Exposition, Annual Show and American Society for Metals, Seminar, Detroit, Michigan.

Oct. 18-20—National Association of Corrosion Engineers, South Central Region, Corpus Christi, Texas.

Oct. 31-Nov. 1—Society of Automotive Engineers, Fuels and Lubricants, Drake Hotel, Chicago, Illinois.

Nov. 3-8—Oil Industry Information Committee, Stevens Hotel, Chicago, Illinois.

Nov. 5-8—American Petroleum Institute, Annual Meeting, Palmer House and Stevens Hotel, Chicago, Illinois.

Nov. 15-17—Rocky Mountain Oil and Gas Association (Annual Meeting), Cosmopolitan Hotel, Denver, Colorado.

Nov. 25-30—The American Society of Mechanical Engineers, Annual Meeting, Atlantic City, New Jersey.

Nov. 26-Dec. 1—23rd Exposition of Chemical Industries, Grand Central Palace, New York, New York.

Dec. 2-5—American Institute of Chemical Engineers, Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, New Jersey.

1952

March 5-9, 1952—American Society for Testing Materials, Spring Meeting and Committee, Cincinnati, Ohio.

March 11-14, 1952—National Association of Corrosion Engineers (Annual Conference and Exhibition), Municipal Pier and Galvez Hotel, Galveston, Texas.

May 21-23—Gas Appliance Manufacturers' Association (Annual Meeting), The Broadmoor, Colorado Springs, Colorado.

June 8-12—Canadian Gas Association, Chateau Frontenac, Quebec City, Quebec, Canada.

NOMADS TO MEET

New York, N. Y., Chapter, First Monday of the Month, Louis Sherry's, New York, N. Y. Secretary Fred J. Jobst, c/o Val. A. Wittich, Jr., 30 Rockefeller Plaza, New York 20, New York.

Houston Chapter, Second Monday of the Month, Ye Ole College Inn, Houston, Texas. Secretary E. F. Baldwin, Hughes Tool Company, Box 2539, Houston, Texas. WO-3101.

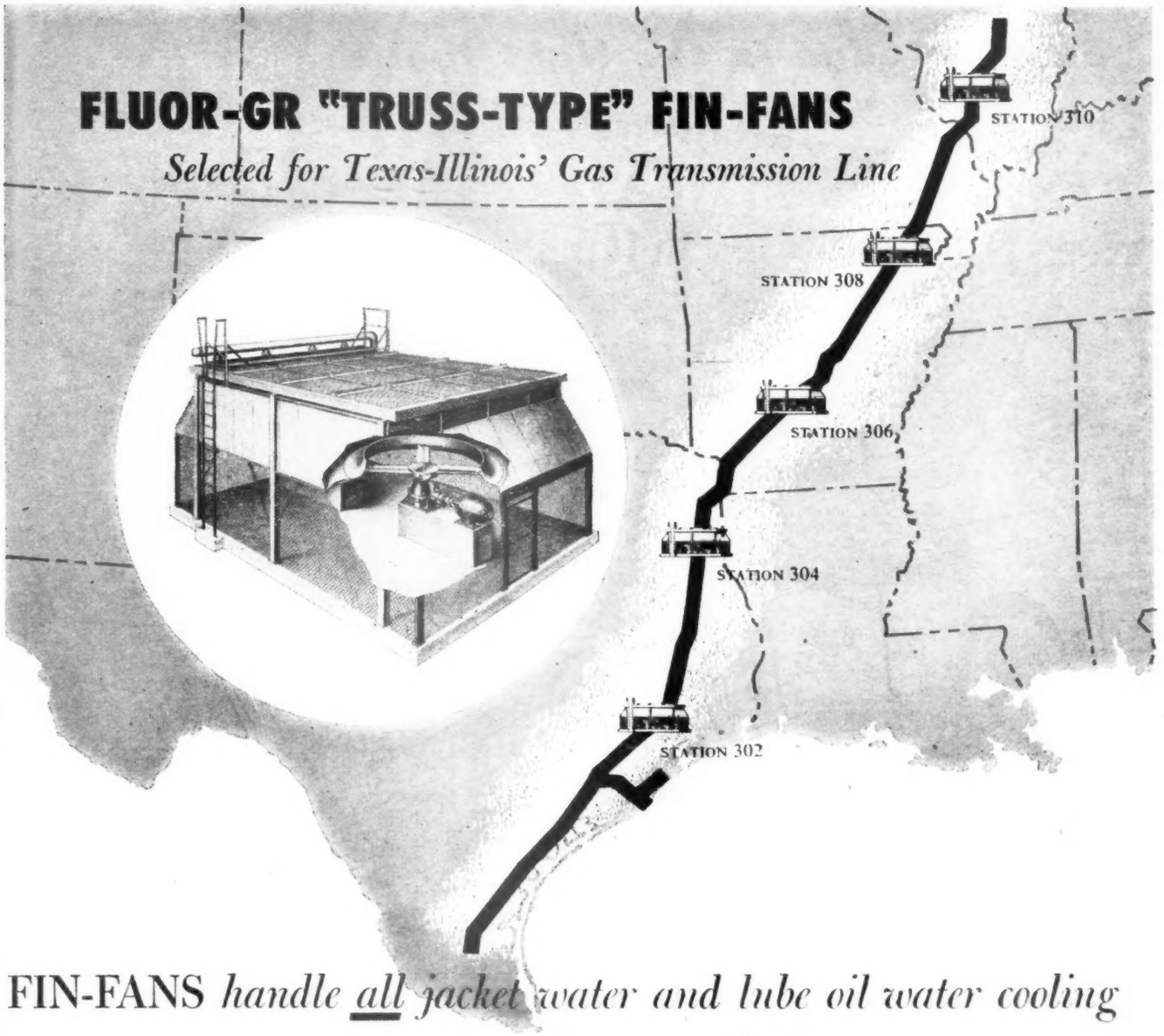
Los Angeles Chapter, Second Wednesday of the Month, Jonathan Club, Los Angeles, Calif. Secretary W. A. Wilson.

Tulsa Chapter, Third Friday, "After Five" Room, Hotel Tulsa. Secretary R. E. Kirberger, Unit Rig Manufacturing Company, Tulsa, Oklahoma.

Dallas Chapter, Dallas, Texas, First Monday of the Month. Except April 9, Dallas, Engineer's Club, Commerce and Browder, May 15, Fort Worth, and October 29, Dallas (Nov. Meeting). Secretary Gene Shiels, 205 Irwin-Keasler Building, Dallas, Texas, Riverside 4042

FLUOR-GR "TRUSS-TYPE" FIN-FANS

Selected for Texas-Illinois' Gas Transmission Line

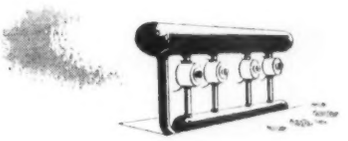


FIN-FANS *handle all jacket water and lube oil water cooling*

The initial five stations on the Texas-Illinois Natural Gas Pipeline Company's 1200-mile, 30-inch gas transmission line are equipped with Fluor's new "Truss-Type" Air-Cooled Heat Exchangers. In addition to economy and dependability of operation, these new "Truss-Type" Fin-Fans are designed for low-cost extension by utilizing end columns of existing units as an integral part of future extensions. When greater cooling capacity is desired, it is only necessary to add to the existing installation—time and space requirements are minimized and the extension can be made without disturbing plant operation.

This new Texas-Illinois line is another major gas transmission system to select Fluor-GR Air-Cooled Heat Exchanger Equipment for compressor station jacket water and lube oil water cooling service. The Fluor Corporation, Ltd., and The Griscom-Russell Company pioneered the use of air-cooled heat exchangers in gas transmission, and remain the leaders in the design and fabrication of such equipment for the cooling of liquids and gases and the condensing of vapors.

The accumulated experience of both Fluor and Griscom-Russell is available to you for your present and future heat transfer problems by contacting any Fluor office. In the meantime, why not send for Fluor Bulletin No. FF 8501 for your files?



FLUOR PULSATION DAMPENERS INSTALLED FOR BOTH SUCTION AND DISCHARGE

To reduce gas stream pulsations and attendant vibration, Fluor Pulsation Dampeners are installed for both suction and discharge service in four of the five Texas-Illinois Natural Gas Pipeline Company's compressor stations.

Design of the Fluor Dampeners is such that at least 85% of all offending pulsations in the gas streams will be smoothed out—insurance for higher operating efficiency, improved flow measurement, lower pipe maintenance costs, and a better safety record.

BE SURE WITH FLUOR

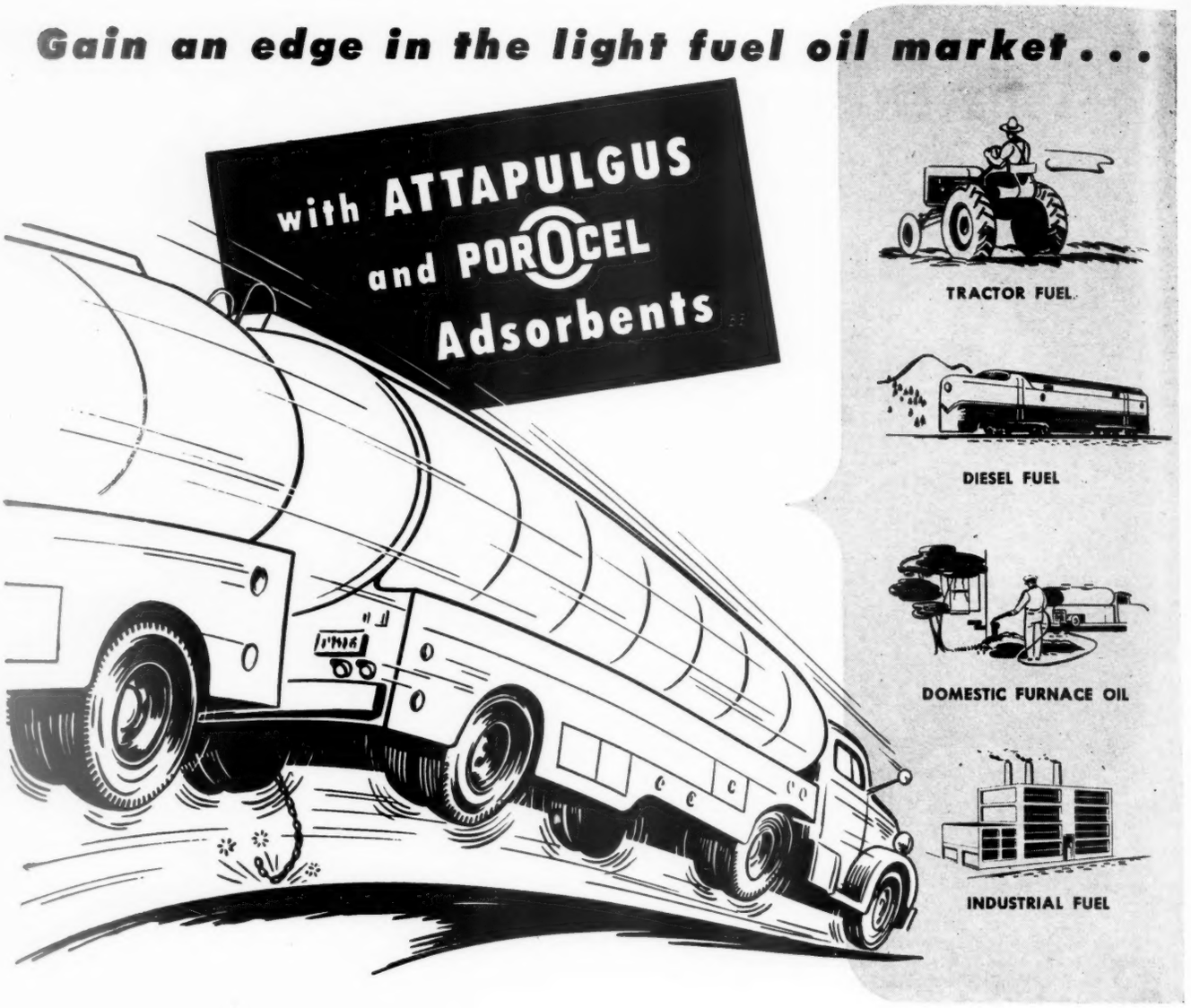
FLUOR

MANUFACTURERS of Pulsation Dampeners, Cooling Towers, Fin-Fan Units, Gas Cleaners and Mufflers.
DESIGNERS AND CONSTRUCTORS of Refining, Natural Gas and Chemical Processing Plants.

THE FLUOR CORPORATION, LTD., 2500 S. Atlantic Blvd., Los Angeles 22, California
New York, Chicago, Pittsburgh, Boston, Tulsa, Houston, San Francisco, Birmingham and Calgary.
REPRESENTED IN THE STERLING AREAS BY: Head Wrightson Processes Ltd., Teesdale House, Baltic Street, London, E.C.1., England

XUM

Gain an edge in the light fuel oil market . . .



In a highly competitive market for distillate fuel oils—Diesel, domestic furnace, tractor, industrial—the refiner who places emphasis on high quality in his products has a decided edge. In fact, selling strategy often is based on points of superiority that assume smaller stature at other times. This applies to other products too—absorption, enrichment, smudge, and insecticide spray oils.

A final straining step using Attapulgus Fullers Earth or Porocel Activated Bauxite is an economically attractive form of light fuel oil quality insurance. These adsorbents are recognized standards for the selective "polishing" of light distillates at low cost. Oils in this range can be filtered to high yields for removal of moisture and sediment. Removal of residual amounts of treating chemicals is accomplished. Moisture haze is removed; color improved or stabilized.

Attapulgus and Porocel adsorbents couple low price with long service life—an unbeatable combination when finishing distillates whose market price generally dictates a minimum of refining expense. Process equipment required is relatively simple and inexpensive—often built from on-site components.

Let's explore the possibilities of improving your position—hence profits—in the light fuel oil market. Our staff is at your service to help select the right adsorbent and the right conditions.

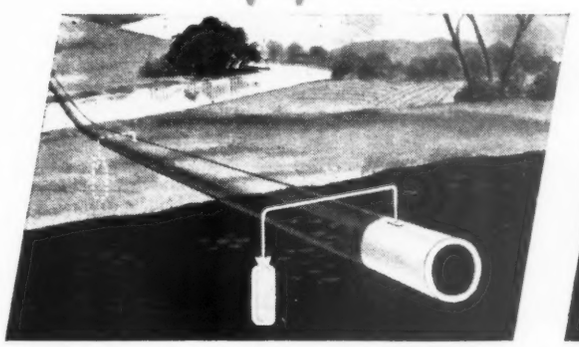
ATTAPULGUS CLAY COMPANY *Fullers Earth* • **POROCEL CORPORATION** *Activated Bauxites*

Dept. Y, 210 West Washington Square, Philadelphia 5, Pa.

To obtain more information on products advertised see page E-45

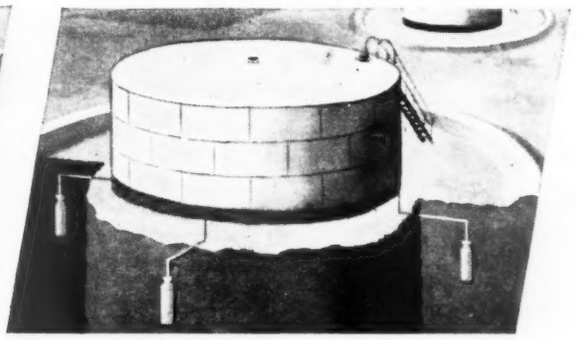
Dowell Magnesium Anodes Cut Corrosion Costs

on pipelines



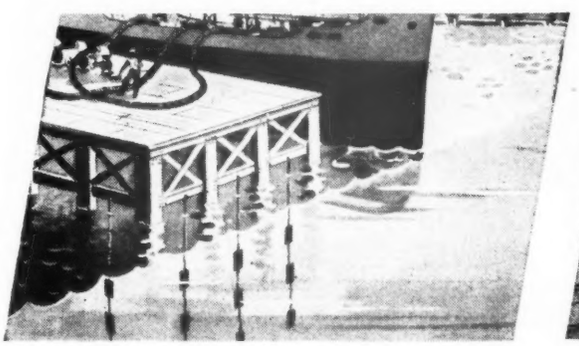
Thousands of miles of buried pipelines are being protected against corrosion at low cost by Dowell magnesium anodes. Such galvanic protection is proving equally effective on coated, wrapped and bare lines.

on tank bottoms



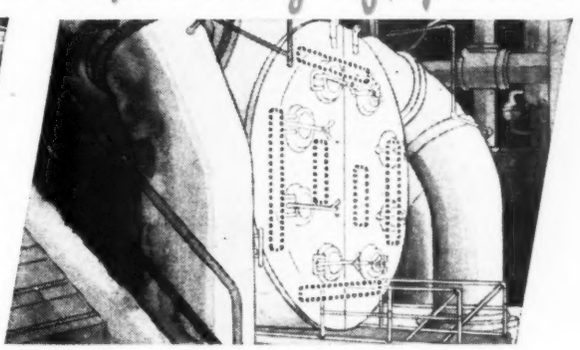
Many firms use Dowell magnesium anodes to prevent the corrosion of the bottoms of large storage tanks. This type of protection is also proving effective for oil lease tanks, gun barrels and completely buried tanks.

on sea water installations



Dowell magnesium anodes are proving satisfactory in controlling corrosion on steel piers, off-shore oil well drilling platforms, ship hulls and other underwater structures.

on operating equipment



The use of magnesium anodes to control corrosion in condensers, heat exchange equipment and many types of processing equipment is gaining wide acceptance.

Galvanic protection with high purity Dowell magnesium anodes has given industry a new way to cut corrosion costs. It has proved effective on a wide variety of installations. A system of Dowell magnesium anodes is easily and economically installed. It requires no external power and only minimum maintenance. Write to Dept. 12, Tulsa for a copy of the free 16-page booklet on galvanic protection with Dowell magnesium anodes.

DOWELL INCORPORATED
TULSA 3, OKLAHOMA
Offices in Principal Cities

DOWELL

MAGNESIUM ANODES

GALVO-PAK® • *GALVO-LINE*

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

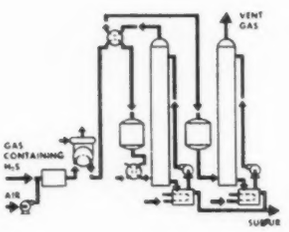
The Mathieson Sulfur Recovery Process | AVAILABLE FROM FLUOR

- **Under ONE Contract**
- **ONE Responsibility**

The proven Mathieson Process for the recovery of elemental sulfur from waste hydrogen sulfide gases is available under *one* contract, *one* responsibility through the Fluor Corporation, Ltd. With over 30 years' experience in the design, engineering, and construction of plants and facilities for the petroleum and chemical industries, Fluor possesses the background, the skilled personnel, and the know-how essential for the practical interpretation of the Mathieson Process into *your* particular sulfur recovery program.

Fluor is in a position to make economic studies covering every phase of proposed sulfur recovery installations—initial investment, operating costs, and returns to the investor.

A Simple Process for the Conversion of Waste Hydrogen Sulfide to Pure Elemental Sulfur



Hydrogen sulfide, recovered from a sour gas stream, is partially burned with air—cooling follows with steam generated being utilized for power. Combustion gases are then passed through a catalyst tower to form sulfur and water vapor. Elemental sulfur product is condensed in a wash tower by direct contact with cooled liquid sulfur. The result is pure commercial sulfur—ready for sale or for conversion into sulfuric acid.

BE SURE WITH **FLUOR**

THE FLUOR CORPORATION, LTD., 2500 S. Atlantic Blvd., Los Angeles 22, Calif.
New York, Chicago, Boston, Pittsburgh, Tulsa, Houston, San Francisco, Birmingham, Calgary.
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To obtain more information on products advertised see page E-45

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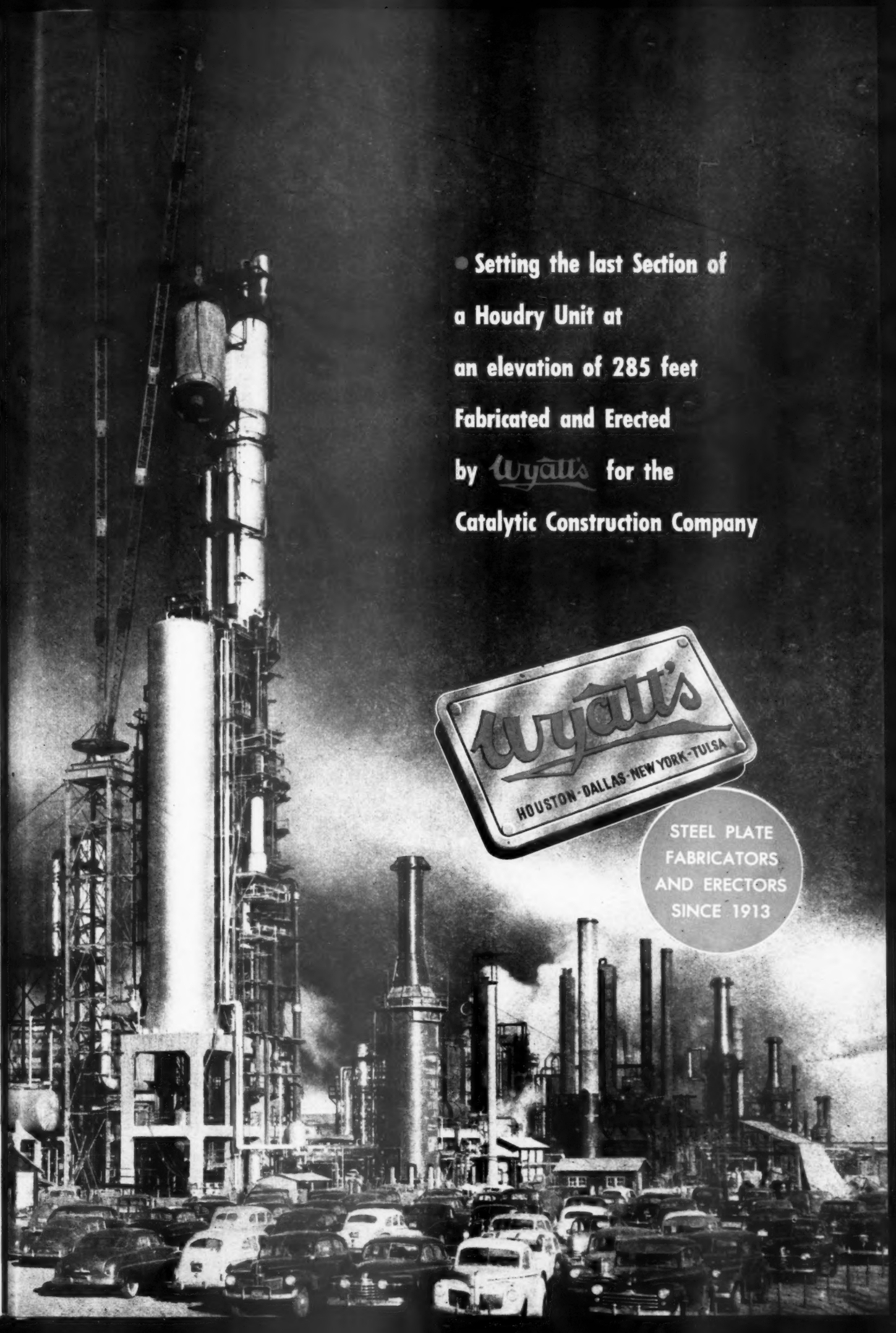
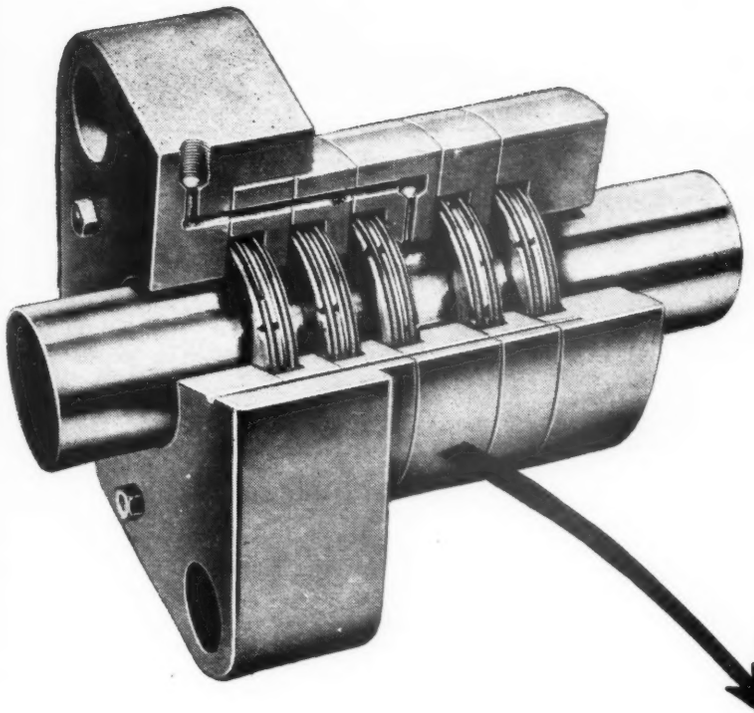

Setting the last Section of
a Houdry Unit at
an elevation of 285 feet
Fabricated and Erected
by Wyatt's for the
Catalytic Construction Company
Wyatt's
HOUSTON-DALLAS-NEW YORK-TULSA
STEEL PLATE
FABRICATORS
AND ERECTORS
SINCE 1913

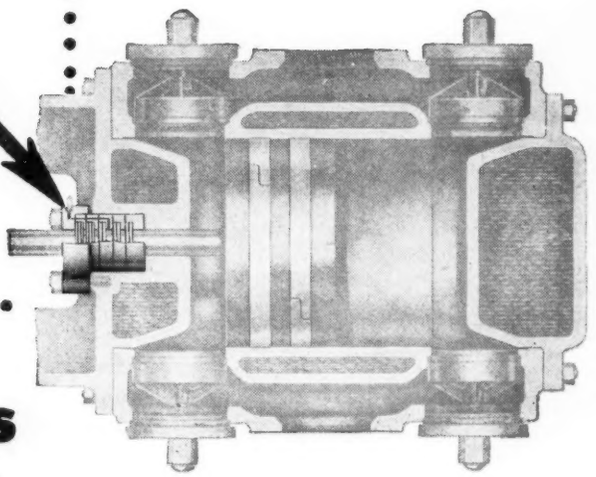
XUM

Watch your pipeline
GO IN FAST
when you wrap with high-strength
Vitron UNDERGROUND PIPE WRAP
More Pipe Wrapped Per Day—new records are being set with high-strength VITRON Underground Pipe Wrap. It's a fact—you can roll all day without a break in the wrap because it's parallel-reinforced with strong glass yarn.
Less Downtime—VITRON-wrapped jobs can go ahead without a stop, roll after roll. That's because it's strong — individual filaments are bonded together securely. It pulls in fast and taut.
Lays in Smooth—because it's porous, allows coating to bleed through evenly for a uniform, all-around-the-pipe protective covering.
Better Finished Job—every mile of pipe wrapped with VITRON promises uniform corrosion-combating properties—with greater impact and stress resistance, fewer "holidays" and greater moisture resistance to help maintain a high dielectric rating.
Write for samples and descriptive engineering material.
Vitron
GLASS FIBERS INC.
1810 Madison Avenue
TOLEDO 2, OHIO
UNDERGROUND PIPE WRAP
VITRON WRAP WORKS UNDERGROUND
resists impact, soil stresses, cold flow and cracking of coating
resists moisture penetration
resists soil acids
helps maintain high dielectric rating



MODERN PACKINGS

boost the efficiency of MODERN COMPRESSORS



COOK

Metallic Rod Packings

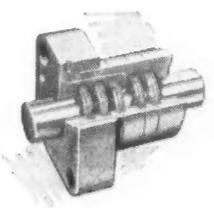
Now, as never before, design engineers are taking advantage of modern friction-reducing devices in order to improve compressor efficiency and dependability.

This is why Cook full-floating all-metallic packings are used as the modern rod seal in so many newly developed compressors. Backed by over 60 years of specialized experience in the manufacture of piston rod seals, Cook packings are designed to function with a minimum of friction. They do this primarily by utilizing rings of proven anti-friction materials. These rings float in specially provided grooves which means that, even when rod vibration or misalignment develops, friction is not materially increased nor is the seal disturbed.

Be sure that your compressor comes equipped with this modern packing. Specify Cook by name when you order new equipment just to make sure.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

COOK GRAPHITIC IRON
ROD PACKINGS



. . . SEALING PRESSURES SINCE 1888 . . .

XUM

ADVERTISERS' INDEX

A

Acme Fishing Tool Co. B-80
Aerofin Corporation E-16
Aerotec Corporation, The D-11
Aetna Ball and Roller Bearing Company B-35
Allis-Chalmers, Tractor Division D-17
Allis-Chalmers B-25
Aluminum Company of America C-52
Amercoat Corporation A-26
American Car and Foundry Company A-11
American Chain & Cable Co., Inc. E-30
American Hoist & Derrick Co. B-66
American Manufacturing Company of Texas A-2
American Meter Company A-15
Attapulgus Clay Company A-16-d
Axelson Manufacturing Company B-52, B-82

B

B and W Incorporated B-68
Baash-Ross Tool Co. B-41
Baker Oil Tools, Inc. B-4, B-5
Baroid Sales Division, National Lead Co. B-1, B-73, D-55
Bechtel Corporation D-23
Bethlehem Steel Company, Shipbuilding Division B-27
Bethlehem Supply Company B-59
Black, Sivalls & Bryson, Inc. E-5
Blaw-Knox Company A-7
Bowen, S. R., Co. B-64
Briggs & Stratton Corporation B-46
Brown Fintube Co., The E-18
Bucyrus-Erie Company B-62
Burgess-Manning Company E-49
Byron Jackson Co. B-69, B-90

C

Cable & Stine B-66
Cameron Iron Works, Inc. B-22, C-2
Cast Iron Pipe Research Association C-53
Caterpillar Tractor Co. B-77
Chapman Valve Mfg. Co., The E-22
Chicago Bridge & Iron Company Inside Front Cover
Chrysler Corporation, The E-25
Clark Bros. Co., The A-62, A-63
Continental Supply Company A-57-A-60, B-56-B-57
C. Lee Cook Mfg. Co., Incorporated A-5
Core Laboratories, Inc. B-99
Crane Co. A-28
Crane Packing Company E-57
Crutcher-Rolfs-Cummings, Inc. D-41
Cummins Engine Company, Inc. E-20

D

Dean Brothers Pumps Inc. E-52
Dearborn Chemical Company D-51
Dowell Incorporated A-38, A-16-e
Drilling & Service B-33
Drilling Specialities Company B-13
DuPont, E. I., de Nemours & Co. C-19-C-22
Durametallic Corporation E-32

E

Eastman Oil Well Survey Company B-101
Emsco Derrick & Equipment Company B-56, B-57
Enterprise Engine & Machinery Co. D-2

F

Fairbanks, Morse & Co. B-29
Farrel-Birmingham Company, Inc. D-19
Fisher Governor Co. E-55
Fluid Packed Pump Co. B-43, B-44
Fluor Corporation, Ltd., The A-16-c, A-16-f, C-51
Foster-Wheeler Corporation C-31, C-32
Foxboro Company, The C-42
Fram Corporation D-58
France Packing Co. E-37

G

Garlock Packing Company, The E-36
Gaso Pump & Burner Mfg. Co. D-1
General Electric Company D-33
Geograph Co. Inc., The B-64
Glass Fibers Inc. A-16-b
Globe Oil Tools Company B-97
Grip-Tite Manufacturing Co. E-62
Grove Regulator Company B-93
Guiberson Corporation, The B-15
Gulf Oil Corporation A-36

H

H & M Pipe Beveling Machine Company D-36
Halliburton Oil Well Cementing Co. Front Cover
Hammond Iron Works A-55
Harrisburg Steel Corporation B-30
Hercules Tool Company B-90
Hill, Hubbell Co. D-4
Hilliard Corporation, The E-38
Hughes Tool Company Back Cover
Humble Oil and Refining Co. A-32
Hyatt Bearings Division, General Motors Corporation B-67

I

Industrial X-Ray Engineers D-18
International Harvester Company A-35

J

Jaeger Machine Co., The D-12
Jensen Brothers Mfg. Co. B-68
Jerguson Gage & Valve Company E-33
Johns-Manville D-35
Johnston & Jennings, Co., The E-32
Johnston Pump Company E-56
Johnston Oil Field Service Corp. B-31
Johnston, M. O., Oil Field Service Corporation B-51

K

Koehring Company A-19, D-25
Krome Co., Inc. E-62

L

Lane-Wells Company Inside Back Cover, B-2, B-24, B-60, E-24
Larkin Packer Co., Inc. B-37
Levingston Shipbuilding Co. B-61
Link-Belt Company B-86
Lufkin Foundry & Machine Company B-19
Lufkin Rule Co., The E-42
Lummus Company, The C-46

M

McCullough Tool Company B-103
McEvoy Company B-55
Magnaflux Corporation E-34
Magnet Cove Barium Corporation B-65
Manning, Maxwell & Moore, Inc. C-29, D-27
Manzel Division of Frontier Industries, Inc. A-20
Mark, Clayton & Company E-14, E-41
Mathieson Chemical Corporation C-38
Mercoid Corporation, The E-48
Midwestern Engine & Equipment Co., Inc. D-49
Miller Sand Pump Co. B-66
Minneapolis-Moline E-31
Mission Manufacturing Co. B-53
Morse Chain Company A-46-A-47
Motorola, Inc. D-34
Murphy Diesel Company B-91

N

National Carbon Company, A Division of Union Carbide and Carbon Corporation C-55
National Supply Company, The A-49-A-52, E-12, E-13
Nicholson, W. H., & Co. E-53
Nicolet Industries, Inc. D-47
Nordstrom Valve Division E-27, E-28

O

Oakite Products, Inc. E-61
Ohio Injector Company, The A-33
Oil Base, Inc. B-71
Oil Center Tool Co. B-49
Oil Well Supply Company B-17
Oklahoma Contracting Co. D-28
Onan, D. W., & Sons B-66
Otis Pressure Control, Inc. B-89

P

Parsons Company D-25
Patterson-Ballagh, Division of Byron Jackson Co. B-47
Peerless Manufacturing Co. B-78
Pelican Well Tool & Supply Co. D-52
Pelton Water Wheel Company, The B-39
Penberthy Injector Company E-40
Petro-Chem Development Co., Incorporated A-17
Petroleum Electric Power Association E-51
Petroleum Engineering Associates, Inc. B-100
Petroleum Rectifying Company C-4
Phillips Petroleum Company, Perco Division C-13
Pittsburgh Coke & Chemical Co. D-45
Price, H. C., Co. D-58

R

Radio Corporation of America E-6
Reading, Pratt & Cady Valve Division, American Chain & Cable Co., Inc. E-30
Rector Well Equipment Company, Inc. B-88
Reda Pump Company B-36
Reed Roller Bit Company B-6
Republic Steel Corporation B-23
Rice Hotel E-39
Ridge Tool Co., The A-18
Rockford Clutch Division B-76
Rockwell Manufacturing Company E-27, E-28, C-17
Roper, Geo. D., Corporation E-61

S

SKF Industries, Inc. A-27
Schlumberger Well Surveying Corporation B-21
Security Engineering Co., Inc. B-32
Shaffer Tool Works B-75
Shell Development Company D-42
Sinclair Research Laboratories, Inc. A-21
Skinner, M. B., Company C-51, D-30
Smith, A. O., Corporation A-31
Spang & Co. B-34
Spang-Chalfant Division, The National Supply Company A-50, A-51, E-12, E-13
Standard Oil Company of California A-30
Standard Oil Company (New Jersey) A-34
Superior Iron Works & Supply Company E-1

T

Thermix Corporation D-11
Thew Shovel Co., The D-37
Thompson Tool Co. E-58
Tretolite Company B-26
Trojan Construction Co., Inc. D-52
Tube Turns, Inc. E-9, E-10

U

Ultra-Violet Products, Inc. E-62
Union Carbide & Carbon Corporation, National Carbon Company C-55
United States Rubber Company A-22, A-23
United States Steel Corporation B-17, B-85
Universal Atlas Cement Company B-95
Universal Oil Products Company C-25

V

Victaulic Company of America B-38
Visco Products Company, Inc. E-44

W

W-K-M Company B-79
Weston Electrical Instrument Corp. C-35
Whitney Chain Company A-1
Wickes Boiler Company A-37
Williamson, T. D., Inc. D-46
Wilson Foundry & Machine Co. B-83
Wilson, Web, Oil Tools, Inc. B-85
Wisconsin Motor Corporation E-60
Worthington Pump & Machinery Corporation A-9, D-14, D-15
Wright Chemical Corporation E-59
Wyatt Metal & Boiler Works A-16a

Y

Young Radiator Company E-7
Youngstown Sheet & Tube Company A-29

Z

Zeligson Truck Equipment Company E-15
Zink, John, Company C-1

IS A PACKER THE BEST ANSWER ON THIS JOB?

ASK YOUR LANE-WELLS MAN!

It sometimes happens that a situation arises which a packer can handle — but where another piece of equipment would serve better. And in these situations you can depend on your Lane-Wells man to give you an honest answer. It's the first step in Lane-Wells Engineered Packer Service to tell you just what equipment will best serve the needs of your individual job.

Lane-Wells men are trained in all the latest techniques in field-proven uses and applications of packers. They can help you plan production and testing set ups; help lay out packer setting and packer pulling programs; advise on selection of packers and efficiency of packer set ups; and can give valuable tips on packer maintenance and repair.

And it's all for free, as you probably know. Engineered Packer Service by Lane-Wells is available to any operator, on request, regardless of the equipment he uses. It can be a big help, as many operators testify, and you're obligated for nothing—so why not

Ask your Lane-Wells Man — Today — about

AP-403

...by...

General Offices, Expert Office and Plant • 5610 So. Soto St. Los Angeles 58, California

LANE WELLS

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Hughes Rock Bits have no Private Life

Never-ending inspection is the lot of a Hughes Tri-Cone Rock Bit. At every stage in manufacture and *use* it comes under someone's close scrutiny.

Shown here is a typical example of what we mean. These engineers are inspecting worn Tri-Cone bits sent in by Hughes field engineers for research analysis and study. Selected from thousands of bits, run on thousands of rigs, they give Hughes the broadest possible information about bit performance under every type of operating condition.

The result of this constant probing by Hughes engineers is *faster hole and more hole per bit!* It accounts for the fact that Hughes Rock Bits are accepted as the standard of the industry...throughout the world.

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